

July 11, 1960

# Aviation Week

and **Space Technology**

**Fan Burner  
Engine Studied  
For Transports**

Transit II-A Dual  
Payload Installed

75 Cents

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## AEROJET'S AbleStar

### RestartABLE

April 13, 1983, marks a dramatic milestone in American propulsion technology—the first successful restart of a rocket engine in outer space. The mission, under Air Force Ballistic Missile Division management—launching of the ARPA-Navy Transit navigation satellite into precise orbit. The propulsion system, Aerojet's AbleStar upper stage,

### EnABLE

AbleStar's spectacular achievement centers to a new phase: the unrivaled reliability pattern of Aerojet's ABLE series—16 tests, 15 triumphs—in firings conducted for the Department of Defense and the National Aeronautics and Space Administration.

### AvABLE

Produced by Aerojet-General, under systems management performed by Space Technology Laboratories, the AbleStar was designed, developed, qualified and flown in less than one year from contract inception. Service, limited to after upper stage impact, are available now for immediate contributions to America's space programs.

A product of the  
Aerojet Systems Division

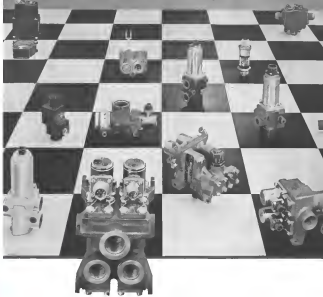
**Aerojet-General\***  
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Azusa, California



## FIRST RESTART IN SPACE



Engineers investigate outstanding contributions of Aerojet



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## AVIATION CALENDAR

July 18-19—Liquid Rockets and Propellants Conference, National Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio

July 15/19: Quarterly Regional Meeting  
 Ave. of Land Transport, Palmer, Beverly  
 Meeting Room, Beverly Hills, CA

July 21-27—Third International Medical Electronics Conference, & Exhibition (including seminar on medical electronics in your research). London, England.

July 28-29: Seventh Annual Symposium on Computers and Data Processing, Dartmouth Research Institute, University of New Hampshire, Durham, New Hampshire

Aug. 17—Fourth Global Conservation Symposium, Baller Hall, Univ. of Maryland, D. C. Speakers: Institute of Reptiles and Amphibians, U. S. Nat. Spec. Comm.

Ang John Tatum, of Mineral Springs, Georgia (Classical Music); lecturer at the Lamont-Doherty 11 Center Hotel San Diego, Calif.

Aug 211-27th Annual U.S. National Senior  
Living Championship. Fort Collins, Col-  
orado, U.S.A.

Aug. 3-11.—Western National Veterinary  
Surgical Association, Chicago  
Hotel Seattle Wash.

Aug. 1912-1960 Pacific General Vantage  
Superior Institute of Pharmacy, Inc.  
Room 11, Century Hotel, San Diego, Calif.

Aug 24-26—11th Annual Congress Int'l  
national Astronautical Federation, Royal  
Institute of Technology, Stockholm

Aug. 16-18—Fourth Annual Conference on  
Frontiers in Biological Effects of Man-  
made Radiation. New York University

Post-Graduate: United School NYU  
Medical Center NYC. Sponsor: La  
Research and Development, Cleveland

Aug. 18-19—Second International Symposium on Submarine and Space Medicine: Education of Teachers and Naval Med-

## ANALYSIS WOOD and Stone Facilities

July 11, 1969  
Vol. 72, No. 2

and the other two are obtained from the derivative of the first two with respect to  $\alpha$  and  $\beta$ , respectively. The three equations are solved simultaneously for  $\alpha$ ,  $\beta$ , and  $\gamma$ . The three equations are solved simultaneously for  $\alpha$ ,  $\beta$ , and  $\gamma$ . The three equations are solved simultaneously for  $\alpha$ ,  $\beta$ , and  $\gamma$ .

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Memorandum: Please send item 104 to Jeffrey Webb  
at 1000 University St. West, 1st Floor, Suite 1000  
U.S. Navy

ANALYSIS WEEK, July 17, 1990

Engineering notes **SM/I**  
from the  
**REPORTER**

BY STANLEY N. INGRAM, Cambridge, England

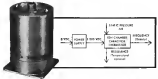


Report No. 7  
TR 2043-2 Glow Discharge Densitometer

This instrument was developed by our Research Division from investigations into ozonolysis phenomena. It employs the glow discharge phenomenon between two electrodes to measure the density of a gas between the electrodes, which enables it to measure the concentration of ozone in an accuracy of  $\pm 1\%$  or better. When this unit is used as a pressure measuring device the accuracy is  $\pm 0.5\%$  of the pressure reading. At this higher accuracy the TR 2045-2 takes over from conventional barometric instruments and measures pressure against elements which are not subject to corrosion by ozone. The instrument consists of a power supply and an ion chamber packaged in a cylindrical stainless steel case four inches long and three inches in diameter. Because it does not depend on fluids, it is not subject to leaks and is extremely attractive to those who, vibration, and anti-vibration.

### Typical Performance Specifications

bits/s	16000 (nominal) or 20000 (maximum)
latency	1000 (nominal) or 2000 (maximum)
accuracy	±0.001 (nominal) or ±0.002 (maximum)
range	0.001 to 1000000
response time	1000 (nominal) or 2000 (maximum)
power requirements	100 mW (nominal) or 200 mW (maximum)
temperature range	0 to 50 °C
humidity	10 to 90% RH
size	100 mm x 100 mm x 10 mm
weight	100 g



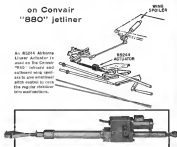
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## Airborne actuator selected for wing spoiler systems

on Convair  
"880" jetliner



Airborne's linear actuators are used by Convair Division of General Dynamics Corporation in the Convair "880" jetliner to provide a secondary lift/drop control system to move control of wing lift/drop should the primary control surfaces become inoperative. By electrically controlling the actuators through a set of switches in the cockpit, the pilot can fly the "880" using the wing spoilers.

Convair's design problem called for an actuator that would operate effectively from sea level to 40,000 ft., at temperatures ranging from -65° to +140°F, and with a duty cycle of 10 sec on, 5 min off at a maximum tension or compression load of 325 lb without any risk of failure even after being stored for long periods of time. Airborne

provided a specially built K5344 test model that requirements with a total weight of only 3 lb.

This is only one example of many specially built Airborne actuators relied on by aircraft designers to carry out vital functions in modern missiles and aircraft. Whenever your special design problem, we will build an actuator to your specifications that will do the job dependably and safely. When your requirements are not unique, we can provide a line of modular-type actuators, both linear and rotary, that can simplify design and specifications. Give us the facts on your particular need and we will be happy to submit a proposal. Contact any of our offices for further information.



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## AVIATION CALENDAR

(Continued from page 7)

- Aug. 15-16—Electronic Packaging Symposium, University of Colorado, Boulder.
- Aug. 21-23—1960 Cryogenic Engineering Conference, University of Colorado.
- Aug. 23-24—Thermal Electronic Beam & Conversion, Los Angeles Memorial Sports Arena, Los Angeles, Calif.
- Aug. 24-Sept. 1—1960 National Air Traffic Control Forum, Chicago, Ill., sponsored by National Aeronautics Assn.
- Sept. 4-5—Civilian, Closed Course Amphibious Race, Edinburg Airport, Cleburne.
- Sept. 5-11—1960 Translanguish Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.
- Sept. 7-8—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Instrument Society of America, American Society of Mechanical Engineers, Aeronautical Institute of Electrical Engineers, Institute of Radio Engineers, American Institute of Chemical Engineers.
- Sept. 8-11—1960 Electric and Electronic Symposium, Newark Corp., Millis, N.Y.
- Sept. 12-13—South Atlantic Electronic Meeting Conference, New York University's College of Engineering, New York.
- Sept. 12-16—1960 Annual General Meeting, IATA, Copenhagen, Denmark.
- Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.
- Sept. 14-16—Annual Meeting, National Assn. of Public Relations Officials, West Hotel Jackson, Wyo.
- Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington.
- Sept. 15-21—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Banquet Hotel, Washington, D.C.
- Sept. 20-25—National Convention and Assembly, Panamas, Air Force Assn., Crowne Plaza and Holiday Inn, San Francisco, Calif.
- Sept. 23-25—24th Annual Convention, Institutional Northwest Airlines Group, Hawaiian Hotel, San Francisco, Calif.
- Sept. 27-30—Space Pulse Systems Conference, American Rocket Society, Museum Hotel Santa Monica, Cosmo Club, USAF, U.S. Army, U.S. Navy, NASA, AEC.
- Oct. 1-5—South Atlantic Communications Symposium, Institute of Radio Engineers, Union, N.Y.
- Oct. 1-5—1960th Annual Meeting, Institute of Radio Engineers' Professional Group on Wireless Systems, Galveston, Texas. Cosponsors: Oak Ridge National Laboratory.
- Oct. 1-5—National Modernization Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.
- Oct. 1-5—1960th International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Council Assn., Sheraton-Palace Hotel, San Francisco.
- Oct. 16-17—Society of Automotive Engineers National Aerospace Meeting, including NASA Office of Scientific Research Aerospace Conference, Anaheim Hotel, Los Angeles, Calif.

## The elements of guidance and control:



**Data Acquisition and Application Subsystems**—IBM has proven capabilities to provide real-time main-frame and machine-to-machine elements of weapon guidance systems. In addition to the Bombing Navigation system with its visual displays in the B-52, IBM also provides interface devices to apply the system to air-launched missile guidance. Federal Systems Division experience in air-based and ground-based guidance systems is proven in operation.



**Data Communications Subsystems**—The SAGE data processing system, heart of America's air defense network, embodies advanced communications devices and techniques required to filter and direct an enormous flow of data. Designed and built by the Federal Systems Division, the AN/FSD-7, an advanced system in operation, embodies processing and communications power to direct defense operations as well as to guide missiles from remote sites.



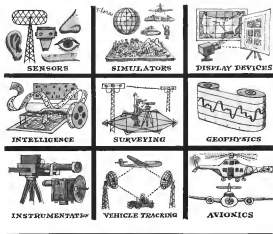
**Data Processing and Control Subsystems**—Now in development, the Advanced Bombing Navigation and Missile Guidance system is another example of IBM's closed-loop system capability. This system caters the operating requirements of high-speed, long-range weapon systems. Compact, reliable equipment such as this and Federal Systems Division's computer for the Titan missile guidance system are the result of IBM's vast background in data processing and control.

## all systems capabilities of IBM

IBM's experience in data processing and data communications, supplemented by an extensive background in data acquisition, adds up to a three-way capability for developing, producing and integrating total automated systems. This capability is being advanced through continuing research in miniature high-speed devices for high-reliability guidance systems of the future.

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A possible Earth to Venus trajectory (dotted line) for 107 day flight programmed for baromet conditions over Cape Canaveral on 16 January 1964 at 13:05 hours (rehearsal time). Illustration shows positions of Earth, Venus, vehicle at nighttime day intervals.



**MISSILE AND SPACE  
 VEHICLE  
 DEPARTMENT**

*...center for missile and space technology research  
 and development at General Electric*

## Progress in defining space trajectories

Aerodynamics at General Electric's Missile and Space Vehicle Department are steadily expanding space ... determining trajectories for flights from the Earth to other bodies of our solar system.

Under these funded studies, MSVD has recently completed a program of error analysis of trajectories to the Moon (involving the Sun body gravitational system, as well as a study of flight paths to Venus).

From consideration of the total gravitational field, specific space missions are computed when date of departure, trip time and launch site are specified. The coast launch baromet conditions are determined for the time of day which maintains the additional boost caused by the Earth's rotation. Employing new techniques, MSVD specialists have made these determinations with as few as three corrective computer runs. These methods also can be applied to flights to other planets of our solar system.

In addition, the Department is developing methods to determine orbital parameters of earth satellites using only Doppler information. The MSVD experience in tracking techniques and computer programs permitted analysis of the Russian Lunik III trajectory.

For more information about MSVD's progress in all phases of space technology, write for the new Department Bulletin, Section 150-22, General Electric Co., Missile and Space Vehicle Department, Philadelphia 1, Pennsylvania.

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Scientists and Engineers interested in career opportunities in Space Technology, contact Mr. E. M. Boring, Dept. 345, MSVD

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Upper photo: Hi-Lok forces the entire faster disc point to side and bottom.

Lower photo: Modified "B" structure tool on faster A. Other Hi-Lok 140 side on beam flange. The Hi-Lok modification to side and bottom, the process of providing to the structure normally used and with the installation of average type fasteners using pneumatic hammers.



## HI-LOK OFFSET TOOLING CIRCUMVENTS STRUCTURAL FLANGES

The change to high strength Hi-Lok Fasteners and Hi-Lok tooling on the Northrop T-38 Talon supersonic jet trainer, overcame acute workability problems caused by wide flanges of structural ribs and beams in the thin, single panel wing. The switch to Hi-Loks from average type fasteners resulted in a substantial savings in installation manhours.

More than a 50% tool cost savings alone was realized at Northrop when average fastener tooling, with its single purpose power units, spacers, yokes and other special tooling was replaced with simple Hi-Lok offset tooling adapted to standard, multi-purpose air driver machines.

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July 11, 1969

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## Value of Bombardment Satellites Doubled

Defense and Air Force sponsor studies of concept, acceleration of space intercept program expected.

## GAS to Coast Military Control Bidding

Defense wanted it will have to pay standard rates, supplemental carrier oppose board policy reversal.

## Fan Burner Dominates Supersonic Designs

But might companies concentrate large portion of advance design effort on fan burners to meet stringent performance needs.

## SPACE TECHNOLOGY

 Bombardment Satellites Scheduled... 36  
 Satellite's Structure Research... 36  
 Space Vehicle to Have Dual-Stage... 37  
 Control Systems for Space Vehicles... 37  
 Recovery System World-Side in Entry... 37

## MISSILE ENGINEERING

 Space Program Critical... 39  
 South Western Supersonic... 39  
 Hypersonic One-Stage Vehicle... 40  
 Navy Working Supersonic Production... 40  
 Navy Underground Launcher Tested... 40

## MANAGEMENT

 Defense Forces Foreign Base Essential... 43  
 Control System With Engineers... 43  
 Computer System for Base Control... 43  
 Space Subject Passed... 43  
 White House... 43  
 Industry Observer... 43  
 Washington Roundup... 43  
 News Digest... 43

## AVIONICS

 Radar Radar Display Pilot Position... 49  
 Self-Service Weapons Control System... 49  
 SAMP II Radar System... 49  
 Radar Radar Display Pilot Position... 49  
 Self-Service Weapons Control System... 49  
 SAMP II Radar System... 49

## BUSINESS FLYING

 New Design, 2000 Horsepower... 150  
 Private Line... 150

## SAFETY

 Improper Recovery Cloud is 707 Crash... 150  
 Letters... 150

## EDITORIAL

Supersonic Transport Born... 20

CORRECTION: First appearance of the word "Navy" in the article "Navy's New...".

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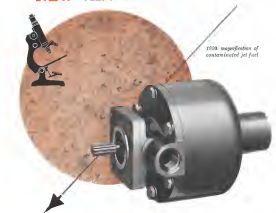
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# New missions for the Agena

The Lockheed-built Agena satellite—used by the U.S. Air Force in its Discoverer, Midas, and Samos programs—has been chosen for another major program. The National Aeronautics and Space Administration plans to use a larger, more powerful version, the Agena B. NASA will use both Atlas and Thor boosters to launch

it. Along the Atlas, the versatile Agena B will vary from a 5000-pound earth satellite to an 800-pound space vehicle. Along the Thor, it will be used for a new series of 1500-pound meteorological satellites. Lockheed is prime contractor and system manager for the Agena and Agena B.

**LOCKHEED****MISILES & SPACE DIVISION**  
BELLINGHAM, WASHINGTON

Agena is America's largest satellite, weighs 1700 pounds on orbit. Agena B is larger, has doubled fuel capacity.

## EDITORIAL

### Supersonic Transport Race

The international spotlight is now focusing on the race to produce an efficient and inherently supersonic transport, with 1960 looming as a year of decision for the contestants. Already the flags of France and the USSR have been run up as challenges for the aeromedical proof, and those of the United Kingdom and the United States should follow soon.

There is little debate over the international prestige that will accrue to the first successful contestant in the supersonic transport race. It will be a technical achievement in the eyes of the world comparable to the first satellite and the ICBM. But there is much more than international technical prestige at stake, although this country certainly would benefit greatly by regaining some of this prestige lost during the early Sputnik years.

Contrary to some opinion, we believe there will be a significant economic plan to be plotted by the first successful supersonic transport producer. The world market for such a vehicle will be substantial, but not nearly as large as the current and still expanding market for subsonic jet transports. The supersonic transport market is likely to provide a profitable enterprise for the first group who enter the field with a vehicle that meets strict standards of economy and safety. The obvious are likely to have rather slim payoffs. The first slush of orders for any given nationality of supersonic transport is likely to elicit enthusiasm for the other government's financial support of their own projects as hopes for a good return on their investment fade.

The United States has led the world at almost every significant new technical stage in the development of modern air transport. Although it has not always been the first in the field with new types of equipment, it has generally proved to be the first in the international transport market with new types of equipment that satisfy strict airline operators' standards of safety and economy. Some of these achievements were possible only through the failure of international competitors who, though first in the market with new equipment, were unable to maintain the competitive pace.

The United States today leads the world in its knowledge of the art of supersonic flight. It has produced and is operating hundreds of supersonic military aircraft ranging from the original Century series of fighters built just past Mach 1 to the Mach 2-plus bombers and fighters now in the air for USAF and the Navy. It would indeed be a tragedy if this hoarding of supersonic knowledge were not properly focused on the problem of developing and producing a supersonic transport that would capture the world market for this type.

At present there is little evidence that the executive and administrative leadership required for this project is

materializing. Almost every company in the air transport manufacturing business has done considerable research and preliminary design study on supersonic transport. The National Aeronautics and Space Administration is still, thanks to some hard pushing by E. R. "Pete" Quasada, Federal Aviation Agency administrator, and John Stack, the research dean of NASA's Langley laboratory, conducting research in the problem areas that loom for a supersonic transport.

The House Science and Astronautics Committee has tried to focus public attention on this project through its open hearings. As a group, it has strongly endorsed this endeavor. "Pete" Quasada has been working hard behind the scenes to upward the top-level executive branch of the government in assuming leadership in the organization and initiation of this project as a national effort.

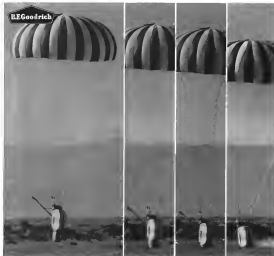
To date, there have been no significant results on the executive organization, leadership and financing of this project, although technical research and study are still continuing.

The hour is growing late in the international supersonic transport race for this type of executive decision. Regardless of the excellence of our technology in this area, it will avail little unless channeled toward significant goals and given the proper stimulus of a national effort.

There are many needs that could be passed toward the goal of supersonic transports. For the promise of being first in the field, a transport version of the Mach 3 Convair B-58 bomber could be quickly converted into being. While it probably would not make an efficient airline type transport, it would provide valuable operational experience in an area that is now a complete mystery to airline operators and would help to lay a sounder foundation for new transport design. Some people have a mystical feeling that a supersonic transport will automatically result now that the B-70 Mach 3 bomber program appears to have regained its proper financial backing. But even the most enthusiastic North American engineers on the B-70 project would be the first to point out that while this project again would provide a valuable technical foundation for supersonic transports, this goal will not be achieved automatically as without further effort any more than the B-47 and B-52 bombers automatically produced the Boeing 707 jet transport success.

Even though it is now too late in the year for the necessary top-level political decisions to get this supersonic transport project initiated, it is not too late for the industry and government organizations concerned to get together in serious conference and draw some firm blueprints for this program to be presented to the new political leadership as early as possible next year.

—Robert Tietz



Three sequential views inflated nose of B-70 nose capsule. In last photo note clear round airbag of vehicle as it is caught through "blowout" valve.

## Engineered "blowout" cushions landing

When this B-70 supersonic lands the ground, the inflated rubber bag on the bottom cushions initial impact—then the bag exhausts through a "blowout" valve just at the point of maximum compression to eliminate any bouncing "yo-yo" motion. The bag must pack in minimum space, must inflate within 3 seconds.

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## WHO'S WHERE

### In the Front Office

**Frederick W. Handcock, Jr.**, president and chief executive officer of Taylor, Inc., Springfield, Mass., a subsidiary of Atlas Corp. Also Arthur M. Rogers, treasurer.

**Donato F. Gray**, a vice president. Chief engineer Engineering Company, Inc., Tucson, Calif. Mr. Gray continues an annual visit to the Colorado Engineering Division.

**Dr. William A. Rink**, vice president, *Aviodynamics, Inc.*, Houston, Tex., and general manager of the Defense and Space Division.

**Stanley S. Schneider**, vice president-general manager, *Toucan Research Laboratories*, Silver Spring, Md.

**Joseph F. Duggan**, vice president and general manager *Warman Instruments Division of Dexters, Inc.*, Newark, N. J. **Edward F. Kluke**, executive vice president.

**Dale A. Lantry**, vice president in charge of the Systems & Controls Group of GenCorp, Chicago, Ill.

**Toucan Engineering, Inc.**, Union, N. J., has acquired an Aerospace Division and has named **Dr. Bruno Balda**, Toucan's vice president for engineering and manufacturing, head of the division. **Edward J. Filaberti** and **Joseph Pelletier** are vice general managers.

**Geoffrey W. Hill**, chairman of *Avcon*, Fresno, S.A., General Belton, succeeded **Richard Foley**, retiring. Also **Arthur Talbot**, managing director, according to E. O. The company.

**William E. Farns**, retired, is the vice president of General Control Radio Co.'s Radio Avionics, Washington, D. C.

**John V. Taylor**, general manager to E. B. Daniels, Administrator of the Federal Aviation Agency, Washington, D. C. **Robert V. Reynolds**, executive vice president, is general manager to **James T. Pike**, Deputy Administrator.

**Col. H. L. Evans**, deputy commander for space systems at *Force Redesign*, Nevada Division, ARDC, Inglewood, Calif.

### Honors and Elections

**James Lowrey** has been inducted into the Air Force Association's World Hall of Honor to receive the Daniel Guggenheim Award for 1960, which is bestowed to "Persons, Engineers, Public Servants, for a lifetime devoted to the advancement of aeronautics in America."

**USAF Capt. Joe E. Jordan** and **Joseph W. Kintner, Jr.**, both ARDC, have been awarded the Harmon Trophy for 1960. Capt. Jordan won the Harmon Trophy for setting a new altitude record of 105,191 ft in a Lockheed F-104C, and simultaneously establishing the first two-man climb in 30-000 feet in 11 min. 4.92 sec. Capt. Kintner received the Harmon Trophy for a record open cockpit ascent and parachute jump of 70,400 ft in ARDC altitude escape research.

**Robert Lee**, a consulting engineer at Westinghouse Electric Corp.'s Electronics Division, has received the company's highest award, the Order of Merit, for technical contributions including the development of the first solid state transmitter.

(Continued on page 178)

## INDUSTRY OBSERVER

■ Army is contemplating a 350 to 1,000-ton stage version of the Merits Perching parachute-system module and has invited industry proposals for an initial guidance system with accuracy required for the longer ranges.

■ Next step beyond Dynaflex orbital glider is a B-type hypersonic stage vehicle that can re-enter the atmosphere at supersonic speeds up to escape velocity. NASA studies show first objective first objective will be reusable. Vehicles must dissipate twice as much energy as airframe from a laser antenna in its re-entry from a low orbit. Dynaflex uses double wall metal structure surrounding insulating material. Super-orbital vehicle will have ablating outer skin, which should reduce guidance problems significantly by widening the altitudinal corridor in which vehicle can fly.

■ Plus under consideration by National Aeronautics and Space Administration to launch Atlas Able VI toward the planet Venus next January has been delayed indefinitely. Scheduled launching of Atlas Able V in a later October has been pushed back from August to Sept. 12.

■ Contract awards for ground and airborne communications packages for Project Advent 24th reconnaissance orbit, real-time telemetry satellite (AW June 28, p. 59) are expected before Sept. 1. Army Signal Corps accepted bids through last Tuesday. Bidders are believed to include: Science/Systems, Aerospace Instruments, Bendix, General Electric's Radio Division and heavy antenna electronics departments, Holloman Electronics, Holloman, Hughes, International Telephone and Telegraph, Motorola, National Public Radio, Radio Corp. of America, RadioShack, Sylvania, Texas Instruments, Western Electric and Westinghouse.

■ Development of a satellite interception under Project Scout is expected to be one of the first major programs undertaken by USAF's new Aerospace Group (AW June 27, p. 25).

■ Feasibility of a wide-band radio communication ship is being investigated by Wright Air Development Division at Dayton, Ohio. It is a series of Aeronautics III flights from Cape Canaveral, Fla. Two or three launches have been scrubbed so far because of equipment trouble. Bids could be used economically to bid system 3,000 sq. ft. of ship if they were interrupted by communications or interference from existing stations.

■ Code signal for Army's Counter IA delivered reporter communication satellite will be changed at 600 sec intervals to ground-based position clock and type mechanism to ensure continuous commercial capability to trigger message transmission from orbit. Launching, scheduled for July 15 (AW July 6, p. 26), now has slipped to August.

■ Bendix Eagle airborne vehicle, under development for Navy's counter-ship missile and other aircraft, is being projected to incorporate a closed-loop fusion propulsion system to maximize effects of aerodynamic and solar heat. System will be built-in, with refrigerant released at rate calculated to heat the entire flight time of the burning aircraft. Another target system is under consideration for USAF Douglas Skybolt air-launched ballistic missile.

■ Naval Ordnance Laboratory has developed a technique that should permit construction of an explosion as large as the 20,000-ton Hiroshima atomic bomb with a charge of only 1,000 lb of TNT. Blast wave generated when a small charge is fired in the apex of a cone represents series of a spherical shock wave generated by a much larger charge fired in the open. Theoretical amplification is 100,000 to one, but even at 25% efficiency, a 2,000-ton cone with an angle of about one-half a degree should simulate blast effect in air or water at a 20 KT bomb.

■ Large scale energy laboratory for investigation of extensive applications of the power source is being conducted by Air Research and Development Command. It would be located at Air Force Missile Development Center, Holloman AFB, N. M.

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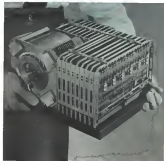
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## Washington Roundup

### Atlas Base Probes

Air Force and Army were ordered last week to explain delays in getting Atlas bases operational. Four Atlas bases at Omaha, New, and Cheyenne, Wyo., are as much as six months behind schedule. Delays are blamed on labor problems and construction deficiencies.

Defense Secretary Thomas Gates asked USAF to prepare a report by the end of last week on status and construction quality of base work. Report was discussed at an Air Council meeting attended by Vice Chief of Staff Gen. Curtis E. LeMay, ARDC Commander Lt. Gen. Bernard A. Silverman and AMIC Commander Gen. Samuel E. Anderson.

Callahan of the Corps of Engineers' role moved Army Secretary Wilbur M. Bricker to investigate the situation. He ordered the Inspector General to look into charges of mismanagement so he could prepare a report for Gates. Bricker's return followed a request for information from Nebraska congressmen.

Watch for the Romans to bid for equal distribution of traffic on a Moscow-New York route as U.S.-Soviet bilateral negotiations. U.S. group headed by Edward A. Reiter, new director of the State Department office of transport and communication, will meet in Washington next week with a Soviet group led by Aeroflot chief Gen. Y. P. Lapshev.

U.S. will start the traffic during move, and the talks probably will produce a Moscow-New York service operated under an agreement based on the Bernese principles.

Senate Armed Services Subcommittee staff also is looking into the Atlas base schedule slippage. It will not be able to report on findings until the Senate reconvenes Aug. 5 after the political conventions.

Senators got a lot of mismanagement charges from co-construction company employee Ben Rennie when he quit his job last month in a protest move. Rennie was assistant project engineer for Griggs & Fuller Co., consultant to the Corps of Engineers.

### Budget System Defense

Franz P. Laszlo, Defense Department comptroller, self-selected the budget watchdog's role in making defense policy last week at a meeting of the Defense Research and Engineering Policy Council. This was the first meeting of the group, which advises Defense Director of Research and Engineering Dr. Elihu York. Yopes discussed included government laboratory competition with industry, military decisions made in scientific and basic research in the three services.

Laszlo argued that Defense expenditures don't control military programs but must meet the President's national fiscal policies into the total defense equation.

President Eisenhower followed the same theme last week, arguing that Democratic-controlled Congress has generally supported his approach to defense policy. He noted that Congress has raised only three of the eight budgets he has submitted—all in election years.

The President diagnosed with the complexity of New York Governor Nelson Rockefeller that more money should be spent on defense. He concluded that Rockefeller is entitled to his opinion, but rejected the suggested spending increase.

Recent nuclear without control is the focus of a Canadian parliamentary controversy. Agreement for nuclear control is under debate. It coincides with the time of nuclear weapons on Canadian soil at a time when public pressure is developing for a nuclear disarmament plan.

Canada will insist on a branch vote as minimum issue in the agreement. Official Canadian position is that NATO nuclear weapons should remain in the hands of the U.S., Britain or France, but the government will insist on having a veto over their use from Canadian bases.

Air Force has assigned electronic support system operational responsibility in a move highlighting the increasing importance of communications. Responsibility for all electronic support systems except communications has been shifted from the office of Director of Communications-Electronics, now called Directorate of Telecommunications, headed by Maj. Gen. Harold Grant to Division of Operations Maj. Gen. Samuel Ager. Both are under Deputy Chief of Staff for Operations.

Senate and House agreed on a comprehensive 20-day extension of supplemental relief spending authority pending a full reauthorization next year. Congressional manual security expenditures was left to be settled after Congress returns from the summer recess.

House passed the bill banning investigation of surface and by air but the Senate is expected to block final action.

—Washington Staff

### Wrapup

# Value of Bombardment Satellites Debated

Defense and Air Force sponsor studies of concept; acceleration of space interceptor program expected.

By Philip J. Klein

Washington—Proliferation and arbitrary usefulness of nuclear armed bombardment satellites (NABS) have been the subject of several recent studies sponsored by Defense Department and the Air Force. Military planners are debating the worth of a system which would be useful to an ICBM force once which could be triggered to reenter from orbit and strike a target area.

Concern over bombardment satellites, expected to accompany the USAF's satellite interceptor program (Project Sentinel), has been sparked by several Soviet events. One was Soviet Premier Khrushchev's statement that the Russians have invented a "fantastic new weapon" which makes existing weapons obsolete. Soviet Maj. Gen. G. I. Pokrovsky mentioned the possibility of bombardment satellites in an article written nearly three years ago, just before launching of Sputnik I.

When U.S. reports, apparently a last on weapons of mass destruction in space, Soviet Union turned down the suggestion. This rejection, however, has been devoted in plans for bombardment satellites, although it probably increased their opposition to international inspection of satellite launch sites.

Military planners will be debating one question which also has to do with the concept of a bombardment satellite:

- **Would it give the Soviet satellite military advantage over the United States?** In the event of a satellite launch, the Soviet Union would be able to launch down satellite orbits with a high degree of accuracy. In fact, this would mean that it should be easier to intercept and destroy a satellite in orbit than an earth-launched ballistic missile would because the element of surprise is diminished.

## 'Easy to intercept'

With a modest amount of high-powered radar, it is a relatively simple matter to locate satellites and establish their precise orbits. From this, it is possible to predict the satellite's future position, which greatly simplifies the task of interception by a counter weapon, NABS opponents claim. Satellite interceptor studies, made under Air Force's Project Sentinel program, on time this year.

Those who oppose an active U.S. program in bombardment satellites and/or doubt whether the Soviets will feel them as offensive weapons, base their views on these considerations:

- **Accuracy.** Fundamentally, and other factors of error on the orbital system. For example, the position of an earth based satellite can be determined far more accurately than the position of

a satellite in orbit. In a ballistic missile, inertial guidance principles need to maintain their position accurately. For only three or four seconds while going in a bombardment satellite, used to maintain a reticulated antenna orientation, must have the accumulated error of many days, weeks or months in orbit.

- **Reliability.** A bombardment satellite could not be given a complete open-ended checkout which is in order to ensure that it would perform as planned when triggered and would not be destroyed. It must be rechecked once the vehicle was in orbit as this can be an ICBM based launch. Thus, the number of bombardment satellites that would have to be placed in orbit would be several times the number of ICBMs required to accomplish any given mission.

- **Economics.** Because of their inherent stresses and vibrations, NABS opponents estimate that it would require at least five to 10 times as many bombardment satellites as ICBMs to achieve a given on-target striking force. Because a bombardment satellite with its command and control equipment would be larger and cost more than an ICBM, and because a larger booster would be required to put the satellite into orbit than to put an ICBM, the cost of a bombardment satellite would be several times that of an ICBM.

If these figures are correct, it would cost \$100 billion to \$200 billion for an all-out program to implement bombardment satellites, to either meet a "security and safety" threat. The triggering of bombardment satellites, which would bring them out of orbit, presumably would be accomplished by radio command. With several hundred in flight, such satellites in orbit after a war could be the possibility that a NABS might be accidentally or intentionally triggered by another nation, precipitating an unnecessary nuclear war.

Some opponents insist that an aggressive satellite program, if undertaken, would U.S. and Soviet space technology, and the point where satellites can be put into orbit could be 100% certain. Thus, there is the possibility that a nation's bombardment satellite with its large nuclear warhead could be launched from orbit and fall on friendly territory or on the launching nation itself. Since the satellite must be designed to stay in orbit for many years for several nations, it is likely that it would be subject to impact. If it did disintegrate during reentry, there still might be a problem of radioactive fallout.

As a weapon of aggression, the bombardment satellite debate is very far from being a matter of impending attack. NABS critics charge, for example, if the Soviets suddenly placed several hundred or thousand earth-orbiting satellites into orbit over a period of several days or weeks before the planned attack, many of them could be used to detect by U.S. radar. This would serve to alert the U.S. and possibly trigger a pre-emptive war.

If the Soviets were to spread out the satellite launching over a period of several months or years, even a slow build-up of hundreds of Soviet satellites in space would still cause us concern and alert the status as the build-up continued. If the Soviets used such a buildup to launch, extending over a period of many months, this would increase the probability of accidental triggering of a satellite and the risk of a satellite war.

In any event, Soviet use of bombardment satellites at a mass level of attack would provide the U.S. with far more alert and warning time than it could ever have for against ICBMs. The Soviet Union has the ballistic missile, Vostok, Vostok-S, and Molot, each with a warhead, NABS critics contend.

Critics of the bombardment satellite claim that the weapon is vulnerable to post-launch interception. In the present cold war environment, a nation equipped with satellite interceptors probably could break down a suspicious satellite during one of its orbits without the risk of provoking a nuclear war, whereas it could not attempt to launch, and another nation's ICBMs in post-launch interception.

In fact, NABS critics contend, it should be possible to destroy the U.S. to launch down Soviet satellites almost as fast as they can be put up, and the Soviets probably would have the same capability for satellite destruction in that direction.

For this reason, NABS critics claim that hardened underground missile sites, mobile launchers and Polaris submarines give the U.S. a stronger force for greater security than a system that could be achieved with bombardment satellites.

Some proponents of the bombardment satellite concede that a coast-to-coast satellite network of defense is aimed with a "cosmopolitan" thermonuclear warhead. But if they were armed with orbit bombs, a handful of satellites would have the capability of destroying the U.S. on only one day, rather than several days. No nation would risk the launching of war if it knew its enemy had a few such super-bombs in orbit which would be triggered by aggression.

Critics of the bombardment satellite concede that such a weapon could cause

the problem of numbers and economics, but they point out that it would greatly increase the risk in launch and of accidental triggering. They also point out that the risk of such a weapon, NABS critics contend.

## NASA's 10 Year Space Program Criticized by House Committee

By Fred Eastman

Washington—National Aeronautics and Space Administration's 10 year program for exploration of the outer planets and the Moon has been criticized by the House Committee on Science and Astronautics charged last week.

The committee specifically criticized NASA's program for the exploration of a nuclear reactor powerplant and the development of the 15 million lb thrust stage chamber F-1 engine. In addition, the committee said most of its members thought that the program was too expensive. It also charged that the program was too slow to get on with it. The committee also charged that the program was too slow to get on with it. The committee also charged that the program was too slow to get on with it.

At the same time, the report criticized NASA for refusing to take over Project Orion, a program of space propulsion in which a series of small nuclear explosions can launch heavy objects or payloads into space.

The committee also recommended a larger Navy space effort. Noting that the Navy has no need for space propulsion or a man-in-space program, it urged the Navy to develop a space propulsion system for use in its ships. The committee also recommended that the Navy develop a space propulsion system for use in its ships.

The House report also recommended that the Navy develop a space propulsion system for use in its ships. The committee also recommended that the Navy develop a space propulsion system for use in its ships.

The report, based on extensive hearings earlier in this year, made these recommendations:

- **F-1 engine.** The program should be expanded in line with other priorities to make a 15 million lb thrust stage chamber model engine available in some possible to supply a backup power plant to the Saturn. F-1 also will provide the space shuttle engine.

- **Before substantial funds are committed to the Orion concept, NASA should determine whether a nuclear engine, rather by itself as a propulsion**

tion with the more conventional engines now in use at conventional sites. A study and more economical method of reducing a launch/launching of the Orion rocket to the field of space propulsion.

- **High priority program should be undertaken to put a manned expedition on the moon in this decade. A firm plan with this goal in view should be drawn up and submitted to the Congress by NASA. Such a plan, however, should be completely integrated with other goals to minimize total costs.**

The committee also recommended that the Navy develop a space propulsion system for use in its ships. The committee also recommended that the Navy develop a space propulsion system for use in its ships.

Lack of funds may stop properly has delayed the F-1 engine program from 12 to 15 months. The report said, pointing out that the National Aeronautics and Space Administration had a request in December 1970, for a DR program for the F-1 and as a result development later was held up due to lack of funding for the development. The report also said Congress had not yet to cut costs made by Congress last year as funds for the program development was further delayed and it was taken as long as six and a half years to complete instead of the 32 to 45 months previously contemplated.

NASA's 10 year program makes no provision for getting a manned expedition to the moon, other than the provision that a manned landing on the moon may take place at the time period beyond 1970, the report said, pointing out that retroverses appearing before the committee testified that manned exploration of the moon would be possible as early as 1975 if pushed hard.

# Satellites Urged for Structures Research

By J. S. Bets

**Washington**—Development of spaceborne satellite technologies for testing structures and materials in space has been given the highest priority among a long list of urgent structural problems by the National Aeronautics and Space Administration's Research Advisory Committee on Structural Design.

Almost the same emphasis was placed by the committee on the need for ground-based test facilities that would allow the space environment as nearly as possible. Such test satellite laboratories and ground facilities are considered necessary for the coordination of satellite engineering design data for space vehicles.

Recommendations of the advisory committee are aimed at clearly defining and assigning priorities to the area in which emphasis is needed in structural research and development for advanced aircraft and missiles as well as space vehicles. The recommendations are so extensive and interrelated that it will be many years before they can all be carried out.

Part one of the report is to provide guidelines for NASA operational groups in their budget planning and management over the next few years. The committee's conclusion was a general review of its work has been published in NASA Technical Note D-5115, entitled "Important Research Problems in Advanced Flight Structures Design, 1964."

Reversible satellite laboratories needed for structural and materials testing will have some form of collapsible sides in extricable form as they operate with large experiment areas can be subjected to the space environment. The specimens would be instrumented so that transient data regarding their condition could be transmitted to the ground. Finally at the end of the test, the specimens could be returned behind the test shield and the satellite could be returned to the earth without the loss of sensitive design specimens or instrumentation.

Ground laboratories used to simulate the test data from space would have three basic major requirements:

- **Blind vacuum** to reproduce the surface phenomena encountered in space with most materials and finishes.
- **Heating and cooling** that reproduce the heating of sunlight and the cooling of shadow areas in space.
- **Hypervelocity "gas"** to simulate the impact of micrometeoroids at velocities not less than 20,000 ft/sec.
- **Positive acceleration** to provide 400 g's for particles in micrometeoroid flows in a chamber large enough to allow the ac-

coustic study of the shielding system.

The advisory committee also recommended immediate implementation of a reversible structure test satellite program and heavy expenditures for the design and construction of the ground facilities. Reversible satellites specifically for structures and materials test are not included in the Fiscal 1969 budget, and only small funding has been provided during that period for ground test facilities of the type recommended by the committee.

The committee included two general classes of problems in the "very high priority class," which ranked below the problems discussed above. These were in the design of pressure vessels and in the development of materials and techniques for containing pyrotechnic high pressure vessels, which will be the main structural elements in space vehicles, cannot be designed properly unless

## Dyna-Soar Research

Washington—Air Force has awarded two preliminary design contracts for large scale free flight models of Dyna-Soar type hypersonic vehicles.

They are scheduled to be ready for flight in 12 months. Actual flight dates of the Mach 20 models will depend on availability of the TF-109A solid propellant booster vehicle.

One contract, covering two aerodynamic models, was won by Flight Systems Laboratory at Buffalo, N. Y. The second, awarded to General Dynamics Corp., was awarded the other contract, covering design of flow structures models.

The aerodynamic models will provide the best large scale data on freestream, heating and pressure distributions over blunt bodies at actual Mach numbers in free flight, at high hypersonic speeds. Data will be instrumental and models possibly will not be necessary. The next Flight Systems Laboratory studies will fit the model scale. It may be as large as one-fourth the size of the free flow.

Main purpose of the structure models is to test full-scale structural parts over the speed range of the Dyna-Soar. Several different types of structures will be subjected to each flight and the model can be subjected to the hypersonic test chamber will be subjected to the same load they would experience on a maneuvering vehicle.

There are several phases in the model development and flight test program beyond the current preliminary design phase, on which 15 companies submitted bids. Contractors for other phases will be selected later.

to better environmental information is obtained through satellite studies. One of the major environmental unknowns today is the frequency and penetrating power of various classes of micrometeoroids. The committee also describes the present knowledge of pressure vessel design as inadequate and recommends that a broad basic research program be implemented in this field for study.

• **Crack propagation** which is not properly understood for aircraft structures and has been investigated only on a limited basis in space vehicle type structures, where the stress level will be much higher and the stress distribution much different.

• **Failure design** on a elementary basis so that accurate design stress can be pulled out to detail.

• **Torsion configurations** as a detailed problem for less so that optimum design can be identified for maximum efficiency.

• **Multiwall pressure vessels** with special emphasis on stress distribution, design and automatic stopping capacity.

Even though the containment of hydrogen warheads has been accomplished as the laboratory for long periods, the reentry forces can be extremely difficult in evaluating the capability to flight structures. From many years for research listed by the committee are:

• **Development of elements** for high speed and broad-based concepts.

• **Development of methods** for easy attachment of instruments, sensors and other instrumentation into pressure vessels made of elemental materials.

• **Development of methods** for the inspection of nonmetallic materials.

• **Development of structural and fluid dynamics** for reentry tanks, not susceptible to brittle fracture and with low thermal conductivities.

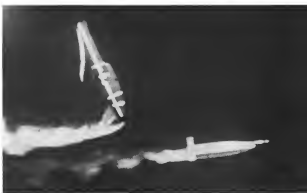
"High priority" classification was given to a number of other problems by the committee. The two placed at the top of this list were the study of structural fatigue and the problem of shielding biological payloads from the ionizing radiation in space.

The committee reports that no method exists as to the present which will allow the satisfactory prediction of fatigue life in any structure. It recommends that the search for such a method be intensified even though great effort is already being applied to it.

The goal of the shielding study is to anticipate the shielding necessary for the reentry periods with the structure of the space vehicle as much as possible. One of the first requirements of this study is to determine what the shielding requirements will be for the various missions even by an order of magnitude.



First Photos Show Separation of Snark Warhead



First photos of separation of USAF Northrop SM-61 Snark's 3,600 lb nose show new warhead is detached from the vehicle as it is target on its own momentum. Aerodynamic drag immediately causes main body of the missile to pitch upward and delay attack. Separation is progressed into steady, which uses internal guidance system and is not under command when it starts target. Snark is powered by Pratt & Whitney J47 jet engine, has a range above 5,000 mi. Snark is combined with 7020 Strategic Missile Wing at Froschle Air Force Base, Mo. Photos are from motion picture film made some time ago in test flight over Atlantic Range.



Convair configuration was chosen for the first nuclear-powered aircraft because it allowed the crew's compartment to be located in weakness due to the (near 100 ft.) from the motor and the aircraft's center of gravity.



Air Force's first nuclear-powered aircraft will be a subsonic test

bed to explore the entire nuclear aircraft concept and to aid in the establishment of requirements for operational systems.

## First Nuclear Plane Details Shown in Convair Design

First U. S. nuclear-powered aircraft, to be built for the Air Force by Convair Inc., Worth, will have a reference, scaled configuration and will be about the same size as the model B-52, weighing around 450,000 lb. Model on these pages shows the present arrangement of the aircraft, which can accommodate either General Electric turbojet or Pratt & Whitney turbojet nuclear engines without major modification. Present Air Force schedule calls for nuclear construction to begin in 12 to 18 months and for extensive flight tests using conventional engines with hydrogenation fuels before the first flight on nuclear power late in 1965. This schedule is based on continuation of the current expenditure rate of about \$140 million per year and no major, unforeseen technical difficulties.



Two aircraft models (below) are placed in the low nuclear reactor to be used in the Convair nuclear aircraft testbed.







## Congress Votes \$39.9 Billion for Defense

By Katherine Johnson

**Washington**—The \$73.9 billion Fiscal 1981 defense budget voted by Congress is a net \$665 million increase over the amount proposed by the Administration. Use of the added funds for key programs—Army modernization, B-70, cargo planes for Military Air Transport Service, a nuclear alert space satellite, C-142, F-44E, four ballistic missile programs—still hinges on approval and release by the Bureau of the Budget and the Secretary of Defense.

Congress increased specific programs, mostly in processing and research and development, by a total of over \$1 billion. Then it applied an across-the-board 5% cut in all other defense categories, which reduced the variance by over \$400 million. Sen. Donat Cattin (D-N.M.), chairman of the Senate Appropriations Military Subcommittee, explained that the action was taken "with the hope that it will give impetus to better operational decisions."

The two main objections to the defense budget voted by Congress came from Sen. Stuart Symington (D-Mo.), who told the Senate that it is "unintelligent for the security of the U. S.," and Sen. Joseph Clark (D-Pa.), who argued

has the kind of delirious spending spree to be expected by \$1 billion a year. Sea Scouting did not rely on passage of the coasters, Sir Clark says, and it. Do find progress, the House vote was 407 to 1, the Senate vote 52 to 4.

Congressional increases for harbors and rivers were partially offset by reductions aimed at forcing economies in administration and operations. The requests of the three services for increased budgets, personnel budgets were cut, and Air Force and Navy requests for operations and maintenance funds were substantially reduced.

The net increase for patent-related R&D was \$415 million; for research and development, it was \$268 million.

The two most controversial programs, which attract several strong Congressional opponents, were \$295 million for a new, congressionally-sponsored Fordist-class carrier for Navy and the Air Force's Boeing Bomarc-B air defense program.

\* A House reduction of \$294 million in the Bureau program—\$40.4 million added for fiscal 1962 plus \$253.6 million in previous appropriations—is reflected. That would have ended the operational program. In final action

Congress restored \$244 million of the Nixon reduction. This left the Reagan-B program with no new funds for Fiscal 1981, and some \$9.6 million from previous year funding.

• **Boeing B-52H.** \$171 million is allocated to complete the objective of 14 hours, bomber wings. Estimated cost is \$7.9 million each.

- **Convair B-58** 5905 million is awarded to complete the program, at a cost of 534.8 million each.

- **North American B-70.** In addition to the S-75 missiles acquired for two prototypes, Congress voted \$190 million to develop the Mach 3 bomber as a full weapons system.

• **Cummins F-905**—Cummins verted \$180 million for the refueling, which was not requested by Air Force, with the provision that the money could be matched by the U.S. government.

• **Bidding:** NC-495, \$224 million, will complete the four-level planned for Fiscal 1967.

- **Republic F-105.** \$115 million is provided to complete the force level objectives for Fiscal 1964.
- **Lockheed C-130B.** In addition to the \$19.4 million asked by the Administration for 25 C-130Bs for non NATO

## Air Force Research and Development Program

Below are details of the approved Air Force research and development funded by the Fiscal 1981 budget. In addition to the projects listed, Congress voted \$193 million for the B-70 program, \$33.5 million for the Space reconnaissance satellite program, and \$80 million which may be applied to Minuteman anticommand-and-control satellite needs, Discoverer research satellite, Alaska missile warning satellite, or in Space. Figures below are in millions.

Operational Development		Space Track	47	MAIS Modernization	103
Strategic Systems	\$1,222.2	Command Control System	50	Test Instruments	50
Sensor	219.9	Shuffles	50	Satellites and Components	71
Ante	192.0	Operational Support	49.7	(Phase)	71
Time	406.8	Support Equipment	27.0	Development Support	18.0
Measurement	29.2	Guidance and Weapons	140	Leeds Laboratory	21.0
6-7a	79.0	Electronic and Communications	136	Alma	20.0
Humid Day	10.6			Space Technology Laboratory	41.0
Studies	2.2	Reconnaissance and Intelligence	5.6	Avia	11.0
Air Defense Systems	62.6	Atmospheric Environment	3		
Main	41.9	Human Factors	57	Research	
Burner	22.1	Targets and Drones	17	Applied	277.0
Studies	1.5			Basic	41.0
Technical Systems	6.7	Advanced Development		Peripherals	112.0
Refueling	5.2	Advanced Systems	305.5	Materials	71.0
Studies	1.5	X-15 Research Vehicle	6.0	Structures	11.0
Control and Support Systems	43.5	Despatch Site Tactical Fighter	38.0	Complexity	3.0
Communications	14.8	Dynalco	30.0	Biometrics	21.0
Intelligence Data Handling	5.7	Anti-ICBM	5.0	Automations	1.0
SAC Control System	16.7	Aircraft Mission Profiles	75.0		
Electromagnetic Intelligence	6.4	Shuttle (CVI 87)	68.0	Command Operations	
Studies		Discovers	15.1	Civilian Personnel	
Weather Observation and Forecasting	6.4	Hyperconcentrated Test System	22	Construction Operational Aspects	120.0
Forecasting	2.8	Area Vertical Takeoff Aircraft	1.7	Supplies and Equipment	64.0
Forecast Targets	4.8	High-Altitude Wing Aircraft	2	Other	2.0



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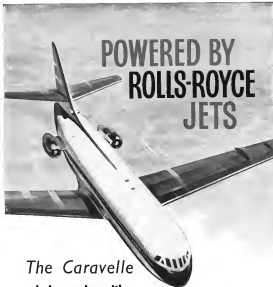
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## Fiscal 1961 Defense Appropriations

(BILLIONS OF DOLLARS)

	FY 1960 Approp.	Request FY 1961	As House	As Senate	By Congress
Army	12.27	14.21	14.40	14.15	14.15
Navy	11.60	13.01	11.90	12.20	12.11
Air Force	17.40	17.00	16.84	16.46	17.10
Department of Defense	1.32	1.51	1.19	1.19	1.19
Total, Department of Defense	32.59	35.73	33.33	33.81	33.55

Included in the table above are the following allocations for personnel and research and development:

### Procurement Appropriations

(BILLIONS OF DOLLARS)

	FY 1960 Approp.	Request FY 1961	As House	As Senate	By Congress
Army Equipment and Materiel	\$1.40	\$1.34	\$1.27	\$1.27	\$1.40
Navy: Aircraft and Materiel	1.10	2.10	2.10	2.01	2.10
USAF: Aircraft	4.35	2.10 <sup>1</sup>	2.32	2.10 <sup>1</sup>	2.32
USAF: Aircraft Materiel			230		210
USAF: Materiel	2.34	2.02	2.35	2.00	2.41

<sup>1</sup> Includes \$200 million included by the House and also in fiscal congressional action under a separate "aircraft materiel" appropriation.

<sup>2</sup> Includes \$200 million for "aircraft materiel."

### Research, Development, Test, and Evaluation

(BILLIONS OF DOLLARS)

	FY 1960 Approp.	Request FY 1961	As House	As Senate	By Congress
Army	\$1.05	\$1.04	\$1.04	\$1.04	\$1.04
Navy	1.41	1.17	1.37	1.15	1.30
Air Force	1.16	1.00	1.04	1.00	1.00
Advanced Research Projects Agency	402	315	300	315	315
Department of Defense					
Emergency Fund	120 <sup>1</sup>	120 <sup>1</sup>	120 <sup>1</sup>	120 <sup>1</sup>	120 <sup>1</sup>

<sup>1</sup> In addition, authority to transfer \$10 million from other appropriations.

staff, both House and Senate Appropriations Committees stated that in instances that \$148 million of the total \$100 million voted for interim MATS modernization should be used to buy an additional 50 C-119s with extended range.

• **MATS aircraft.** The House and Senate Appropriations Committees gave varying instructions as to what type of planes should be purchased with the remaining \$60 million for interim MATS modernization.

The Senate group said it should be a long range turboprop or turboshaft type aircraft with adequate volume and cross section for combat equipment, with provision for strategic loading. The House committee specified that it should be a "side-loading type [which will require the least modification, and thus provide the most immediate delivery] as opposed to the development of a winged type."

In addition to the \$200 million for interim MATS aircraft, Congress approved, without controversy, \$10 million for development of an advanced cargo transport to serve as the future backbone of MATS operations.

• **USAF interim.** The budget includes \$6.8 million for 18 Convair T-27s, \$168 million for 144 Northrop F-105s and \$14.5 million for 52 North American T-28s.

• **Airborne Alert.** The \$170 million voted to develop an on-the-shelf capability is twice the \$85 million previously requested. In addition, Congress gave the President authority to use any funds that might be required for an air alert.

• **Convair A-10.** \$1.2 billion in the fiscal 1961 budget provides for full financing through fiscal 1963, of the 15 planned squadrons of the subsonic tactical ballistic missile. The first seven squadrons will have 10 missiles, and the last six will have 11 each.

• **Marine Corps.** The budget provides \$1 billion to complete financing of the proposed 34 squadrons.

• **Minutemen.** The budget includes \$395 million for development and production of the sub-precursor tactical ballistic missile.

• **North American Hawk Dog.** \$170 million is provided for the air-to-ground missile.

• **McDonnell Quad.** \$71.2 million is scheduled for the air-launched defense missile.

• **Airborne missiles.** Air Force funds

are provided for three missiles: Hughes GAR 1A, \$9.5 million; Hughes GAR 1A, \$13.8 million; Philco GAR-6A, \$20 million; Hughes GAR 11, \$41.5 million.

• **Lockheed P-3.** The \$1.1 billion approved by Congress for the first ballistic missile program includes \$350 million for missiles. The budget would lack enough for medium-powered intermediate and partially financed. The \$1.1 billion program recommended by the Administration, including \$200 million for missiles, would fully fund three days and partially fund one.

• **Nike Zeus.** Congress voted \$237 million, the full amount requested, for research and development on the anti-missile missile.

## Space Budget Passed, FAA, CAB Funds Cut

Washington—Congress approved the full fiscal 1961 budget request for the National Aeronautics and Space Administration before recessing until August, but it cut budget requests for military construction, the Civil Aeronautics Board and Federal Aviation Agency.

Congress passed three appropriations: • **National Aeronautics and Space Administration—1915 million** for fiscal 1961. The House voted only \$175 million, but the Senate increased this to \$915 million. Of the \$915 million approved in House-Senate conference, \$175,760,000 is for salaries and expenses, \$621,475,000 for research and development and \$118,765,000 for construction and equipment.

• **Civil Aeronautics Board—\$73,332,000** for fiscal 1961, up \$1 million less than requested. Of this amount, \$65 million is for air carrier subsidy and \$7,332,000 is for salaries and expenses.

• **Federal Aviation Agency—\$680,494,000** for fiscal 1961, a reduction of \$22.5 million from last year's budget request. This includes \$175,064,000 for expenses, \$165,218,000 for establishment of air navigation facilities, \$93 million for equipment and maintenance, \$44.5 million for construction at Washington National Airport and \$2,416,000 for expenses and construction at Dallas International Airport.

• **Military construction—\$994,515,000** for fiscal 1961, a cut of \$125 million from budget request. As approved, military construction for the Air Force amounts to \$608,201,000; Air Force Reserve, \$4 million; and Air National Guard, \$17,059 million. Army military construction budget is \$146,477,000; Army Reserve, \$4,000,000; and National Guard, \$17,546,000. Navy military construction is set at \$162,519,000, plus \$4 million for the Naval Reserve.





**FAUCETT DC-4** completes loading out at Cusco. Loadings are normally made in this direction to take advantage of the moderate uphill grade. Passengers often gather around the runway to watch the aircraft, but in this case an arriving athlete brought out a crowd.

## Faucett Seeks Route Between Peru-U.S.

By Wilfred H. Gagey

Lima, Peru—Faucett Airlines is departing from its 11 years of mountain and jungle flying, exclusively within Peru with an application for a route to the United States.

The airline, founded by an American and still owned partially—20%—of it by Faucett, is about to take delivery of its first Douglas DC-6 which will be brought to zero engine and airframe time by Pan American World Airways in Miami. Peru's bilateral treaty with the United States provides for the Meritt service Faucett wants, and if the Civil Aeronautics Board approves, Faucett's application, the route would be served with DC-6s.

For the immediate future, Faucett will place the first piece of permanent equipment it will own on its principal passenger route within Peru—from Lima to Cusco, the heart of the Inca Indian empire, a tourist attraction now and potentially a major one.

Though not unique in Peru, the Cusco route is an unusual one by conventional airline standards. Flown now by re-equipped Douglas DC-8s or occasionally by a DC-3A, Panagra developed cooperation with Pratt & Whitney R2800 engines replacing Pratt & Whitney 1830s, the route requires crossing a section of Cordillera Huascarán in some rugged ridge of the Andes at 23,000 ft and landing at the airfield, used 2,578 ft long strip at Cusco which

has an elevation of 10,840 ft. A twice-weekly DC-3 cargo-passenger flight to Quesnoy M6 and Ibarra also stopped at Cusco.

The strip has a small uphill grade, and takeoffs and landings are made only in one direction to take advantage of the grade. The DC-4 flight naturally offloads fuel to get off again for Lima.

Faucett flies its scheduled trips to Cusco in the summer. This often the best combination of loading light winds at Cusco for the one-way landing and for avoiding either the severe thunderstorms likely over the mountains during the Peruvian summer from November to May or of fading Lima fog during the South American winter when low ceilings can be expected on the coastal plain in the afternoon if the weather is satisfactory.

The Cusco DC-4 flight departs from Lima with a maximum permissible gross weight of 61,000 lb and with a fuel load of from 1,600 gal maximum for this flight to maximum fuel load of 3,800 gal. To save altitude, the flight usually for Peruvian weather until it reaches Peru, about 100 mi to the south.

By this time the flight has gained 9,000 ft at which point the airplane's engine systems automatically switch on and the engines are placed in high bypass. The DC-4s carry two oxygen bottles brought to 400 psi—enough oxygen for 15 passengers and crew for 34 hr.

Pilots use masks, but the passengers take their supply from rubber tubes



**FUEL** is offloaded in doses of necessity to bring the DC-4 down to the maximum gross weight for takeoff from the 10,800 ft elevation field at Cusco. The stop is a real long. No servicing other than passenger handling necessitates a done here.

with pipework style mouthpieces which are provided at each seat.

There are two untrained attendants and a steward on the DC-4, the latter using a portable oxygen bottle and mask.

Though this AVIATION WEEK editor found them a good deal more awkward to use than a truck during a recent flight to Cusco and return, they are much more practical for passenger use since they are quickly removable and can be removed with a stroke-enclosed manometer for each flight. The flow is constant and the passenger works out the himself a system of loading and unloading.

The flight goes out for Cusco and continues its climb until it reaches the normal cruising altitude of 20,500 ft. Oxygen flow is automatically increased as altitude is gained.

### Cruising Altitude

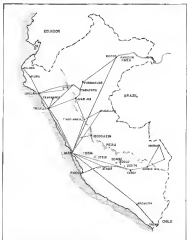
Cruising altitude will carry the flight on top of the first high range of the Andes with peaks at 15,000 to 17,000 ft. Approaching Cusco, however, the flight follows a relatively narrow valley, running roughly southeast with three 20,000-ft peaks following in succession in the range to the north. The passengers actually found himself looking up at the top of the last one—Cerro Salomonte, about 20,574 ft, most topped the airplane's altitude.

Because of the altitude, stalling speed of the DC-4 is higher at Cusco. At 55,000 lb, landing weight with 45 deg flap, for example, the sea level stalling speed of 70 mph increases to 90 mph.

In satisfactory weather the DC-4s will operate at high as 25,000 ft going into Cusco.

The DC-3A, if flown there, can reach 24,000 ft, cruising altitude.

No night flights are operated into or



**ROUTE MAP** shows Faucett's mountain and jungle terrain. DC-4s operate to Cusco, Arequipa, Tarma and Ayacucho. Chachabamba at the north is a cargo operating base and the route shown from Chachabamba and Tarma on upper right map. Main edge of the Andes running north-south through Peru is outlined. Jungle belt to the east.



**FAUCETT DC-4** arrives at Ibarra Airport in Lima, Peru. C-46 and DC-3 is both ground belong to TAMI, Peruvian military airline.



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PASSENGERS are shown using portable oxygen system on Cuzco flight.

out of Cuzco to the field has no lights. There is a non-directional beacon at Cuzco and at Uro southeast of Cuzco. The only bad weather procedure permitted is to pass the Cuzco station to the west and climb, make a 150 deg. turn at Uro and hit down. If the altitude isn't broken out at 16,000 ft., the company procedure calls for immediate climb to cruising altitude and return either to Lima or to the nearest alternate, which is Puno.

Maximum takeoff weight for the DC-4 at Cuzco is 34,000 lb. If the airplane has too much fuel, it is offloaded into drums and taken by surface transport on outward to a jungle strip called Lower Mid where Faucett serves a sub-terminating operation with cargo DC-3s.

No fueling or other servicing other than baggage handling is done at Cuzco. The flight is scheduled to leave Lima at 6 a.m. daily and requires 1 hr 45 min. at 240 mph. TAS. As fast as the airplane can be scheduled and cleared for the return flight it is turned around and taken off for Lima again, with arrivals scheduled at 11:30 a.m.

Takoff is west, downwind and jet style; engines are run up with brakes on until full power is reached and brakes are released.

Cuzco is one of four routes served by Faucett's four DC-4s. Two others, one to Talara north of Lima and the other to Arequipa to the south are flown over the low, narrow coastal plains of Peru. The fourth goes to Iquitos in the jungle at the headwaters of the Amazon river and also involves crossing the high Andes.

Forecasting weather and airport conditions tend to overwork utilization in scheduling. One airplane is assigned to each of the four routes, and there is no effort to take an airplane around from Cuzco, for example, and turning it

around at Lima to fly the Arequipa segment.

Extra revenue, not unusual at Cuzco during the tourist season, are gained by conducting the Talara flight, which can then be scheduled for late in the day. Cuzco Talara has night landing aids at the airport.

Training flights and maintenance are scheduled during the non-scheduled hours. Faucett's aircraft show a high standard of cleanliness and the airline's operations director, Gen. F. A. P. Revuelto Revuelto, and guest captain in place on careful maintenance because of the large amount of mountain flying performed.

Faucett has a Federal Aviation Agency approved overhaul shop at its central base at Leoncio Prado Airport at Lima and maintains two aircraft U.S. military aircraft as well as its own.

Gen. Revuelto and Faucett is properly interested in tailoring reports to its long-range expansion plans and in considering establishing turbine engines and maintenance facilities. Both the Vickers Vanguard and the Lockheed Electra are being studied seriously, he says.

An aircraft like the Electra has natural advantages on Faucett's disadvantage routes utilizing small fields, but wide dispersal capability is a need on the proposed Lima-Panama-Miami route.

Economic considerations are pushing Faucett to its expansion money. For a passenger flight from the United States to Cuzco, Peru. Revenues generated out Faucett aims only 10% of the revenue—Lima Lima to Cuzco—and this is paid in Peruvian notes that have suffered from inflation. But, he adds, Faucett must purchase its aircraft in hard-to-obtain and expensive dollars.

Also a contributing factor is the recent appearance of the Peruvian airline APLA, which has been flying DC-6s

between Lima and Miami with satisfactory passenger loads. Faucett has no competition within Peru, except for the Peruvian military airline TAM in the sense that NAFSA may be regarded as competition by U.S. airlines.

Faucett has 11 DC-3s, primarily used in cargo operations in the north. It has one DC-4A and will buy another from Panagra, from which it also bought its first DC-4. It has 45 pilots and copilots and a total of 650 employees.

Four Faucett-built single-engine engine-managers P-14s powered by Pratt & Whitney Whirl engines still are operated by the airline for special charter work. These aircraft are based on the Stearn SM 10 Defender that made up the original Faucett fleet.

Faucett publishes no annual report, but the number of passengers served has been growing in the neighborhood of 110,000 a year and cargo moved on the order of 15,000 tons.

No cargo operations have been handicapped by a currency problem, but are important in a country like Peru with difficult terrain for surface transport. Its recent cargo effort is the supply of a Cuzco de Puno oil exploration operation in the jungle at its base in which it flies in the drilling equipment to a strip located out of the front for the project.

The airline founder, Elmer Faucett, was an American who came to Peru in a merchant and who took out his last pay as being losses which his employees were bankrupt there. Later he found hidden who provided \$40,000 to buy two Stearn Defenders and his airline was launched. He died last April.

## Allegheny Proposal Rejected by Board

Washington—Curtis Associates Board has denied an Allegheny Airlines request for the consolidation of an application for takeover rights between New York and Washington in the New York State Bar Investigation.

Allegheny has proposed the lifting of the restriction requiring non-stop service between New York and Washington and the lifting of the restriction on non-stop service between New York and Washington in the New York State Bar Investigation. It moved to consolidate this application in the New York State Bar Court on grounds that existing legislation against interstate non-stop service between New York and Washington and operate such service profitably as a part of their long-range services.

The Board denied the motion because "Allegheny has failed to show that its plan to operate such service between New York and Washington is a part of their long-range services. Allegheny and it filed its motion on grounds that its non-stop service between Pittsburgh and New York is not currently profitable."



## The Convair F-106 sets record as world's fastest jet aircraft...

powered by a Pratt & Whitney Aircraft J-75 jet engine

At Edwards Air Force Base on December 1, 1959, the F-106 all-weather interceptor soared to a new world speed record of 1,525.95 miles per hour. Flying a straightaway course at an altitude of 40,000 feet, it bettered the previous official world mark by 122 miles per hour.

On March 1 this year, the Air Force F-106 also demonstrated that it has low-level striking power. At elevations of 50 to 300 feet, under most adverse conditions, the F-106 averaged 700 miles an hour in a 300-mile flight from Edwards Air Force Base.

Pratt & Whitney Aircraft's J-75 jet engine powers the F-106. With this same engine, Republic's F-105D fighter-bomber recently set a new speed record for closed-course flight. Over the years, Pratt & Whitney Aircraft J-57 and J-75 jet engines have held virtually every major flight record.

**PRATT & WHITNEY AIRCRAFT**

Full World Commercial  
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## First Boeing 707-120B Turbofan Transport Flies

First Boeing turbofan-powered jet transport—a 707-120B for Australian Airlines—arises in maiden flight from Boeing's Transport Division at Renton, Wash., powered by four Pratt & Whitney JT3D-1 turbofans at 17,000 lb. thrust (view angle). The 120B turbofan modification of the wing leading edge between the fuselage and midspan wingbox has more sweepback and addition of three segments of leading edge flap (AW Aug. 24, 1959, p. 36). After Federal Aviation Agency certification, American plans to modify 24 120s to the B-707-120B configuration; company now estimates cruising speed will be 440 mph. Qantas Empire Airways of Australia has ordered three of the turbofan-powered transports and later will modify its present fleet of seven 120s to the newer model. The JT3D-1 engines also will be installed on Boeing 720B turbofan transport (AW June 23, p. 46).

## Settlement of Six Year Rate War In Latin America Appears Unlikely

Washington—Prospects for a settlement of the airway rate war in Latin America involving more than 60 carriers operating in Latin America now appear dim despite promising signs last year that some compromise could be reached.

The better credit, increasing fuel rapidly increasing competition throughout the continent, has blocked airline members of International Air Transport Association from doing more in that area.

Although an optimistic situation does exist, there is no indication that IATA members are ready to enter their faces to meet the lower rates offered by a number of Latin American carriers—in some cases as low as 40% under standard rates.

Here is the background to the current price battle:

- Last year, IATA member airlines were granted an exemption which would permit them to cut fares by as much as 10% below the lowest rates offered by competitors. The exemption was never applied by any of the IATA airlines, and a resolution cancelling the exemption was passed by the Honolulu traffic conference (AW Oct. 18, p. 33).
- Meeting of governments in Rio de

Janeiro early last year (AW Jan. 19, 1959, p. 39) resulted in an agreement in principle that IATA rates would be accepted as standard rates on all South American routes. It was further agreed that fare as effect at that time would be frozen to state off any further rate cutting until the airlines of the governments involved could meet to evaluate the effectiveness of a tariff structure.

- Meeting of the airlines in Lima (AW Mar. 23, 1959, p. 38) gave more pressure than at least the members of the Latin American carrier would conform to a standard rate structure subject to experience of the governments involved.

IATA members have granted that would prevent individualized airlines to sell tickets at a fare 50% below regular rates for a period of one year.

- IATA traffic conference in Honolulu agreed on a rate standard for South America to be effective April 1, 1960. However, the rates were never actually closed since few carriers were willing to lead themselves to standards which might not be generally recognized in South America.

An eastern new trend, rate-cutting is as rampant as it was before the govern-

ment and carrier conferences gave more hope that an equitable rate structure was in the making. So-called underdeveloped airlines, which last year were operating second-hand equipment on irregular schedules, have now modernized their fleets and improved their services. Nevertheless, they continue to take advantage of the 1959 exemption granted underdeveloped airlines despite the fact that the one-year period provided for the exemption has long expired. One airline spokesman observed in *Aviation Week*: "How is it possible for an airline operating a fleet of brand new Boeing 707s to consider itself underdeveloped?"

One airline, a Panamanian carrier, is offering a 10% discount to all airlines and tourists of Peru. In Chile, carriers are selling tickets at rates of exchange well below the standard rate of exchange which U. S. carriers must charge.

Some airlines operate equipment equivalent to the first-class equipment provided by the larger carriers but continue their operations to profitable routes, thus providing a 20% reduction on other tickets. In some areas, a 45% discount has been the practice for a number of years and still remains in effect.

Although IATA carriers are not ready to fight back by cutting prices, they are maintaining in force through some rate stability through consultation with the governments and the carriers involved in the rate-fixing.

**WHAT'S IN  
YOUR  
AIR CARGO  
FUTURE...**

Route pattern complexities of typical airlines demand a cargo aircraft with the capability of operating over both short and long route segments with excellent economy and earning ability. The Canadian Forty Four will do this for you! It combines the air cargo feeder line with the long range aircraft to provide a standardized economic fleet unit. The Forty Four will give you profit-making operations, at current rates, over route segments as short as 393 miles and as long as 4,300 miles.

Practical applications of this are found in the short route cargo services that use secondary in the supply and the distribution of goods to or from the terminal points of transcontinental and trans-Atlantic services. This is evident between the major cities of the Eastern United States and between the principal points of Europe. These latter city relationships extend to checking in and through services and with the Forty Four can be handled without a change of aircraft.

#### SOME RUNWAY AND PAYLOAD SPECIFICS ON THE FORTY FIVE-DA

1. From runways as short as 6,000 feet, can operate with 30% payload up to stage distances of 3,000 miles.
2. Can operate from 85% of the world's major airports, with close tolerances to both runway length and allowable wheel loading.
3. Will earn an operating profit with load factors as low as 30%.
4. Break-even load factors in the Forty Four represent low loads on larger proposed equipment.
5. Break-even load factors on larger proposed equipment represent major profit payloads on the Forty Four.
6. Can operate non-stop on the London-New York route with an extreme payload, instead of over 55,000 lbs.

**New York** Time-West Airlines Inc. last week announced its eight-month pay raise for ground employees in an effort to lure a salesman that by Windows had attracted 135 of its crew's 700 New York-based airside workers.

The airside crew, most of them assigned to TWA's international division, were among the last to profess signing a new contract with the carrier (ENR 7/16 p. 47) which they said would be the last to ever enter into with the company.

At the weekend press report from Time, the file historian TWA reacted to supervisor's criticism of the unionized clerical workers in order to work

to handle fewer international destinations, even though they were de-manded by passengers.

A feck of bitterness within TWA's cockpit crew apparently was engendered by the ground crew's decision to submit all contractual issues to arbitration. Many historians and some pilots contended that the union backed a majority of its membership in air traffic controllers' union, the National Air Traffic Controllers Association (NATCA), which also represents TWA's ground crew sales airside. This group contended that arbitration biases heavily in favor of unions and that acceptance of arbitration would not comprehend the air's problems.

## ALPA Opposes FAA On Medical Question

TAA medical officers scheduled a meeting with the Air Log Pilot Assoc late last week to discuss pilot objections to the wording of the form, which requires pilots to agree to a release of personal medical histories from their personal physicians to the agency.

Defending the new firm, which was created a month ago, FAA contends that the 27-question medical history, plus the water protection permitting the agency to query private physicians on the applicant's health, are a commonplace adjuncts of the same information contained in many insurance policy applications.

Reason for the change, FAA said, stems from the agency's need for greater background information on the incidence of heart conditions, diabetes and mental disorders, which have been the subject of special pilot certification

As a partial example of the need for this detailed information, FAA cited scientific investigation evidence that the pilot of a Piedmont Airlines DC-3, which crashed near Charlottesville, Va., last October with a loss of 26 lives, had been receiving treatment from two physicians prior to the accident. Had the new medical form been in use, agents, spokesmen point out, the pilot would have been required to report this treatment and, on the basis of further medical examination, might have been grounded.

FAA emphasizes that it has no interest in the occasional traffic connection but is attempting to discover pilots who may have a lengthy pattern of such violations. Such an individual, FAA said, is likely to be irresponsible and therefore an unsafe flyer who should not be awarded a license.

Typical of that problem is the recent case of a Missouri dentist who had a record of eight light aircraft crashes in five years, FAA said. Although it was suspected he had been flying while under the influence of alcohol, the subject was completely sober during the accident investigation which followed. A check with the local police department later revealed that in the same five year period he received 15 citations for drinking and driving.

Scott Air, Ill.—Military Air Transport Service has awarded two contracts totaling \$1,916,503.62 to two small California airlines to provide outfit support for the Belvoir Medical Division of Air Force's Air Research and Development Command.

The contracts, effective through Fiscal 1985, were with ASA International Airlines Inc., for \$1,681,478, and to Northern Express Airways, Inc., for \$235,025.62.

Using a Douglas C-74C and a Douglas C-118A, furnished by the government and "typically modified to carry aircraft components and engineering personnel," ASA will fly five round trips weekly between California and Florida. In addition, ASA will use a Douglas DC-6A to make two round trips per week between Los Angeles International Airport and Miami AFB, Fla., with intermediate stops.



## Airline Officer Salaries Filed With CAB

	Passenger Revenue	U.S. Mail	Express	Freight	Charters	Total Operating Expenses	Total Operating Revenues	Income Before Taxes
<b>SEGMENTED RESULTS</b>								
American	\$9,327,245	\$19,730	\$44,898	\$1,884,737		\$5,767,640	\$6,046,404	\$1,327,407
Amtrak	\$5,676,495	\$64,448	\$1,493	179,344	32,723	\$4,221,465	\$5,719,719	\$1,488,886
Capital	\$1,911,843	\$24,204	142,553	59,711	17,172	\$1,627,460	\$2,079,148	\$661,235
Comet	\$2,392,265	\$1,995	14,805	63,550	34,209	\$2,447,824	\$2,503,869	\$56,045
Delco	\$9,132,880	\$74,208		944,900		11,823,880	\$1,970,880	\$1,931,000
Eastern	\$3,567,485	\$43,243	\$6,348		71,254	\$3,647,386	\$3,647,386	\$0
Extranet	\$5,135,999	\$43,243	\$6,348	177,421	46,493	\$5,305,476	\$4,846,574	\$458,902
General	\$2,367,485	\$43,243	\$6,348			\$2,417,076	\$2,417,076	\$0
Mountain	\$3,319,448	\$51,762	14,849	71,494		\$3,453,553	\$3,453,553	\$0
Northwest	\$6,453,492	\$146,382	\$245,073		1,152	\$6,845,000	\$6,845,000	\$0
Rocky Mountain	\$2,453,492		\$1,180,293		134,779	\$3,768,564	\$5,554,760	\$1,786,196
United	\$2,370,449	\$43,243	\$6,348		134,475	\$2,554,515	\$5,554,760	\$1,786,196
Western	\$4,935,499	119,748	72,212		91,385	\$5,139,844	\$4,678,454	\$461,391
<b>INTERCOMPANIES</b>								
American	\$23,340	\$4,528		47,484		\$12,730	\$78,438	\$4,193
Amtrak	\$55,196	18,885		\$2,523	59,598	\$19,768	\$85,441	\$111,443
Comet	\$288,219	2,430		14,346		399,191	\$51,669	\$4,794
Delco	\$99,000	6,740			9,768	\$47,440	\$60,000	\$12,560
Eastern	\$1,193,191	49,187		10,764		\$1,252,147	\$1,331,411	\$79,264
Extranet	\$74,213					2,302	\$76,515	\$2,302
Northwest	\$74,747	772		490	3,289	\$3,000	\$1,426	\$1,426
Rocky Mountain	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
United	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Western	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Passenger Revenue	\$23,340	\$4,528		47,484		\$12,730	\$78,438	\$4,193
Freight	\$55,196	18,885		\$2,523	59,598	\$19,768	\$85,441	\$111,443
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United	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Western	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Passenger Revenue	\$23,340	\$4,528		47,484		\$12,730	\$78,438	\$4,193
Freight	\$55,196	18,885		\$2,523	59,598	\$19,768	\$85,441	\$111,443
Comet	\$288,219	2,430		14,346		399,191	\$51,669	\$4,794
Delco	\$99,000	6,740			9,768	\$47,440	\$60,000	\$12,560
Eastern	\$1,193,191	49,187		10,764		\$1,252,147	\$1,331,411	\$79,264
Extranet	\$74,213					2,302	\$76,515	\$2,302
Northwest	\$74,747	772		490	3,289	\$3,000	\$1,426	\$1,426
Rocky Mountain	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
United	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Western	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Passenger Revenue	\$23,340	\$4,528		47,484		\$12,730	\$78,438	\$4,193
Freight	\$55,196	18,885		\$2,523	59,598	\$19,768	\$85,441	\$111,443
Comet	\$288,219	2,430		14,346		399,191	\$51,669	\$4,794
Delco	\$99,000	6,740			9,768	\$47,440	\$60,000	\$12,560
Eastern	\$1,193,191	49,187		10,764		\$1,252,147	\$1,331,411	\$79,264
Extranet	\$74,213					2,302	\$76,515	\$2,302
Northwest	\$74,747	772		490	3,289	\$3,000	\$1,426	\$1,426
Rocky Mountain	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
United	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Western	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
Passenger Revenue	\$23,340	\$4,528		47,484		\$12,730	\$78,438	\$4,193
Freight	\$55,196	18,885		\$2,523	59,598	\$19,768	\$85,441	\$111,443
Comet	\$288,219	2,430		14,346		399,191	\$51,669	\$4,794
Delco	\$99,000	6,740			9,768	\$47,440	\$60,000	\$12,560
Eastern	\$1,193,191	49,187		10,764		\$1,252,147	\$1,331,411	\$79,264
Extranet	\$74,213					2,302	\$76,515	\$2,302
Northwest	\$74,747	772		490	3,289	\$3,000	\$1,426	\$1,426
Rocky Mountain	\$1,976,448	\$74,208	\$48,642			\$1,976,448	\$1,976,448	\$0
United	\$1,976							

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**W. A. Kelly** director, industrial sales  
\$2,111; no other income  
performed as engineer and 350 shares of  
common stock. **R. E. Smith** director, 600  
shares and director, no salary income or  
other compensation \$215 income and  
1,000 shares of common stock. **J. H. Johnson**  
director, reported two thousand and thirty  
shares of common stock. **R. E. Smith** director,  
1,000 shares of common stock. **R. E. Smith** di-  
rector, reported 222,340 shares, \$2,000,000  
and 1,000 shares of common stock. **R. E. Smith** di-

Up to stock, 4 M. Mazzeo, consulting engineer  
RD418 Selkirk Bldg. & 6000 Avenue  
and  
Indiv. comm. 15,321 equipment and  
to stock, 2 W. Walker, architect, and  
architect engineer 15,190, 21,671 select  
77 tons or Indiv. comm. 1414  
equipment and no stock.

Following items were sold by auction  
engineer RD704 14-1, Spence & Andrews,  
Engl. 1-4-61 David Weiss, consultant,  
Engl. Proj. Management & Co., building

**Alkane Asphalt, Inc.—C. F. Kille, Jr.**, president and director, 272-50 equity, 10,000 shares and interest compensation, 25,000 warrants and 4,000 shares of common stock. **R. W. Offord**, senior vice president, treasury, 45,000 equity, 200,000 shares, 100,000 warrants and 100 shares of common stock. **R. H. Hartwick**, treasurer and

1980-1981, 1982-1983, 1984-1985, 1986-1987, 1988-1989, 1990-1991, 1992-1993, 1994-1995, 1996-1997, 1998-1999, 2000-2001, 2002-2003, 2004-2005, 2006-2007, 2008-2009, 2010-2011, 2012-2013, 2014-2015, 2016-2017, 2018-2019, 2020-2021, 2022-2023, 2024-2025, 2026-2027, 2028-2029, 2030-2031, 2032-2033, 2034-2035, 2036-2037, 2038-2039, 2040-2041, 2042-2043, 2044-2045, 2046-2047, 2048-2049, 2050-2051, 2052-2053, 2054-2055, 2056-2057, 2058-2059, 2060-2061, 2062-2063, 2064-2065, 2066-2067, 2068-2069, 2070-2071, 2072-2073, 2074-2075, 2076-2077, 2078-2079, 2080-2081, 2082-2083, 2084-2085, 2086-2087, 2088-2089, 2090-2091, 2092-2093, 2094-2095, 2096-2097, 2098-2099, 2100-2101, 2102-2103, 2104-2105, 2106-2107, 2108-2109, 2110-2111, 2112-2113, 2114-2115, 2116-2117, 2118-2119, 2120-2121, 2122-2123, 2124-2125, 2126-2127, 2128-2129, 2130-2131, 2132-2133, 2134-2135, 2136-2137, 2138-2139, 2140-2141, 2142-2143, 2144-2145, 2146-2147, 2148-2149, 2150-2151, 2152-2153, 2154-2155, 2156-2157, 2158-2159, 2160-2161, 2162-2163, 2164-2165, 2166-2167, 2168-2169, 2170-2171, 2172-2173, 2174-2175, 2176-2177, 2178-2179, 2180-2181, 2182-2183, 2184-2185, 2186-2187, 2188-2189, 2190-2191, 2192-2193, 2194-2195, 2196-2197, 2198-2199, 2200-2201, 2202-2203, 2204-2205, 2206-2207, 2208-2209, 2210-2211, 2212-2213, 2214-2215, 2216-2217, 2218-2219, 2220-2221, 2222-2223, 2224-2225, 2226-2227, 2228-2229, 2230-2231, 2232-2233, 2234-2235, 2236-2237, 2238-2239, 2240-2241, 2242-2243, 2244-2245, 2246-2247, 2248-2249, 2250-2251, 2252-2253, 2254-2255, 2256-2257, 2258-2259, 2260-2261, 2262-2263, 2264-2265, 2266-2267, 2268-2269, 2270-2271, 2272-2273, 2274-2275, 2276-2277, 2278-2279, 2280-2281, 2282-2283, 2284-2285, 2286-2287, 2288-2289, 2290-2291, 2292-2293, 2294-2295, 2296-2297, 2298-2299, 2300-2301, 2302-2303, 2304-2305, 2306-2307, 2308-2309, 2310-2311, 2312-2313, 2314-2315, 2316-2317, 2318-2319, 2320-2321, 2322-2323, 2324-2325, 2326-2327, 2328-2329, 2330-2331, 2332-2333, 2334-2335, 2336-2337, 2338-2339, 2340-2341, 2342-2343, 2344-2345, 2346-2347, 2348-2349, 2350-2351, 2352-2353, 2354-2355, 2356-2357, 2358-2359, 2360-2361, 2362-2363, 2364-2365, 2366-2367, 2368-2369, 2370-2371, 2372-2373, 2374-2375, 2376-2377, 2378-2379, 2380-2381, 2382-2383, 2384-2385, 2386-2387, 2388-2389, 2390-2391, 2392-2393, 2394-2395, 2396-2397, 2398-2399, 2400-2401, 2402-2403, 2404-2405, 2406-2407, 2408-2409, 2410-2411, 2412-2413, 2414-2415, 2416-2417, 2418-2419, 2420-2421, 2422-2423, 2424-2425, 2426-2427, 2428-2429, 2430-2431, 2432-2433, 2434-2435, 2436-2437, 2438-2439, 2440-2441, 2442-2443, 2444-2445, 2446-2447, 2448-2449, 2450-2451, 2452-2453, 2454-2455, 2456-2457, 2458-2459, 2460-2461, 2462-2463, 2464-2465, 2466-2467, 2468-2469, 2470-2471, 2472-2473, 2474-2475, 2476-2477, 2478-2479, 2480-2481, 2482-2483, 2484-2485, 2486-2487, 2488-2489, 2490-2491, 2492-2493, 2494-2495, 2496-2497, 2498-2499, 2500-2501, 2502-2503, 2504-2505, 2506-2507, 2508-2509, 2510-2511, 2512-2513, 2514-2515, 2516-2517, 2518-2519, 2520-2521, 2522-2523, 2524-2525, 2526-2527, 2528-2529, 2530-2531, 2532-2533, 2534-2535, 2536-2537, 2538-2539, 2540-2541, 2542-2543, 2544-2545, 2546-2547, 2548-2549, 2550-2551, 2552-2553, 2554-2555, 2556-2557, 2558-2559, 2560-2561, 2562-2563, 2564-2565, 2566-2567, 2568-2569, 2570-2571, 2572-2573, 2574-2575, 2576-2577, 2578-2579, 2580-2581, 2582-2583, 2584-2585, 2586-2587, 2588-2589, 2590-2591, 2592-2593, 2594-2595, 2596-2597, 2598-2599, 2600-2601, 2602-2603, 2604-2605, 2606-2607, 2608-2609, 2610-2611, 2612-2613, 2614-2615, 2616-2617, 2618-2619, 2620-2621, 2622-2623, 2624-2625, 2626-2627, 2628-2629, 2630-2631, 2632-2633, 2634-2635, 2636-2637, 2638-2639, 2640-2641, 2642-2643, 2644-2645, 2646-2647, 2648-2649, 2650-2651, 2652-2653, 2654-2655, 2656-2657, 2658-2659, 2660-2661, 2662-2663, 2664-2665, 2666-2667, 2668-2669, 2670-2671, 2672-2673, 2674-2675, 2676-2677, 2678-2679, 2680-2681, 2682-2683, 2684-2685, 2686-2687, 2688-2689, 2690-2691, 2692-2693, 2694-2695, 2696-2697, 2698-2699, 2700-2701, 2702-2703, 2704-2705, 2706-2707, 2708-2709, 2710-2711, 2712-2713, 2714-2715, 2716-2717, 2718-2719, 2720-2721, 2722-2723,

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**Al-Khazir Inc.**—Inventory sold for \$100,000; net income \$10,000. The company's net income was \$10,000. The company's net income was \$10,000.

## B Approves Hughes

### Permitting 707, 880 P

Kingston—Gill Associates Inc. has secured a \$266 million financial pact between the Houghton Tug and Traws World Airlines which will enable the airline to purchase 25 707 and 20 Conquer 550 jet

rights of the Botings are currently owned by TWA from Hughes. The Botings are included in the financing package. TWA will assign its interest and obligations in the financing aircraft lease under terms which call for TWA to sell \$500 million in 5½% to 6% bonds and \$100 million in notes to the automatic credit facility.

to the nation's stockholders. Writing to the common stock, they take the form of common convertible subordinated debentures or subordinated debentures detachable common stock preferences, the fixed dividend also has guaranteed TWA a net return of \$100 million in the event the common stockholders fail to offer.

Should Hughes' income rise above \$100 million, although it may not, the company will give shareholders a share of the income earned over the \$100 million.

common stock: 2 A. Red  
corvettes and 31 cars.  
1498 engines and 3115  
in stock. S. T. Road  
car 111,778 salary 4100  
of shares of common stock  
received 11,200 salary 1100  
of shares of common stock  
sector 411,500 salary 1450  
of shares of common stock  
via president-maintenance  
11,5 salary 1100 received  
of common stock. E. 2  
gross. 10,500 salary 1450  
all shares of common stock  
the 101,000 salary 1100  
of shares of common stock  
a legal request was made  
for, collected, listed 1112

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ation were not paid a salary, chairman of the board, trustee and 14,100 to chapel. C. J. Johnson, 1170 St. Louis, 100 shares of common and 100 of preferred, holding common stock. E. E. Stephens, 1000 E. 10th St., 100 shares of common and 100 shares of preferred.

**TWA Pact,  
urchases**

the full offering and also lend the seller an additional 10 cents to complete the deal and keep the corner's profit above \$10 million. In the event of these arrangements, a short

been pointed out that mix of a \$100 million the TWA stock transaction require the number to 100% of the

12% gain would only be questions of control the present overabundance of the airline by flight enable stock gain ramp

<sup>2</sup> Expresses 4 server baggages

<sup>2</sup> **Property Rights**  
<sup>3</sup> **Business Structure**  
 are subject to the following:

<sup>†</sup>Overriding profit or loss  
Freight & carrier charges  
percentage based

<sup>a</sup> Public 33, 1990 (in April 20, 1991  
Journalism, Carleton).

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#### MEET SOME OF THE AIRCRAFT/MISSILE/SPACE SPECIALISTS BACKING UP THE WESTINGHOUSE SALES ENGINEER:



**A. M. Brown**, Engineer in Charge,  
Aviation Facilities Group  
Apr. 52  
B.S., Iowa Institute, 1940  
M.S., Mathematics, University of  
Pittsburgh, 1946  
Specialist in Air Model Aero-  
dynamic and Thermodynamic  
Test Facilities, R&D Research  
Facilities  
Works with Westinghouse: 2



**W. D. Mahler**, Engineer in Charge,  
Aviation Facilities Group  
Apr. 41  
B.S. in E., University of Southern  
California, 1939  
Specialist: Wind Tunnel, Acoustic  
Finger Test Facilities,  
Air Force Park Laboratory,  
Cincinnati  
Works with Westinghouse: 1



**R. A. Perinetti**  
Apr. 79  
B.S. in E., Northwestern College, 1942  
Specialist: Air Model Aero-  
dynamic and Thermodynamic  
Test Facilities, R&D Research  
Facilities  
Works with Westinghouse: 2



**R. F. Lerner**  
Apr. 73  
B.S. in E., University of Illinois, 1933  
Specialist: Air Flow Tunnel, Acoustic  
Finger Test Facilities  
Works with Westinghouse: 2



**F. J. MacIntyre**  
Apr. 56  
B.S. in E., Ontario University, 1939  
Specialist: Aerodynamic Flow and  
Air Flow Test Facilities  
Experiences from 1941  
Works with Westinghouse: 2



**J. Shalinski**  
Apr. 41  
B.S. Chemistry, Westinghouse,  
Pittsburgh, University of Pittsburgh,  
1939  
Specialist: Air Dynamics and  
R&D Research Development  
Works with Westinghouse: 12



**R. C. Lee**  
Apr. 40  
B.S. in E., Ohio College of Science,  
Cincinnati, 1941  
M.S., Engineering, Cornell  
University, 1949  
B.S. in E., Cornell University, 1949  
Specialist: Air Dynamics and  
R&D Research Development  
Works with Westinghouse: 2



**R. A. Ziegler**  
Apr. 41  
B.S. in E., Westinghouse College of  
Science and Technology, 1941  
B.S. in E., University of Pittsburgh,  
1949  
Specialist: Free Spine to  
Ladder, Dynamic, Static  
and Aerodynamic  
Works with Westinghouse: 2

Westinghouse

## AIRLINE OBSERVER

► Watch for another bid by The Netherlands for additional operating rights for KLM Royal Dutch Airlines within the U.S. Passenger gate is a popular route to the U.S. West Coast, a demand that has developed since negotiations between the two countries. Dutch again will back their efforts with sup-level government pressure on the U.S. KLM now serves New York, Miami and Houston as its routes to the U.S.

► Philippines, meanwhile, has extended operating permits of U.S. airlines into Manila for four months. Permits expired July 5, after U.S. and the Philippines failed to reach accord on negotiating terms of the bilateral transport agreement between the two countries. Philippines will also apply strong government pressure on the U.S. in efforts to extend capacity of Manila service. Philippine President Corason Garcia discussed the issue with President Eisenhower during his recent visit to Manila, but no concrete results were made. Philippine government is pushing the issue position of a transport route as part of national policy. Legislation has been passed granting subsidy to the airline for any losses it may sustain in the proposed operation. Meridian bilateral agreement which expired June 30 has been extended to Aug. 15.

► Lockheed Electra transport thrusts now will require approximately 18 days per aircraft. Program was scheduled to start last week at Burbank, Calif., where all modification work is to be done.

► Ethiopia has signed bilateral air transport agreements with Ghana, Guinea and Liberia to permit first time-Africa scheduled air service above the equator. At the present time, flights between east and west Africa are completed by connections at Paris, Frankfurt or Athens. Route will be operated by Ethiopian Airlines and Ghana Airways.

► Panagra raised its twice weekly Douglas DC-6B schedule from New York to Buenos Aires July 1 to four weekly flights with the delivery of another DC-6B. Approval of the service route Buenos Aires was received only at the last minute. U.S. Airline bilateral talks currently are devoted to other flight frequency issues. Pan American World Airways has had, in effect, to give up two panama-cable flights for one per flight into Argentina in the past. Panagra and the Argentines still are negotiating over conditions, but for the present Panagra is operating its usual DC-6B and DC-7 schedule.

► United Air Lines began first Boeing 720 medium-range jet transport service last week, four days after the airplane was certified by the Federal Aviation Agency. Initially, the schedule will be operated on the carrier's Chicago-Denver-Los Angeles and Pacific Coast routes.

► Logging export development still stands as a major jet service problem in South America. Long-hauling of loggers at Santiago, Chile, is not scheduled to begin until next year. At Lima, the new international airport is ready, but loggers from the city will not be completed for another month. Meanwhile, jet transporters are landing at the Las Palmas military airfield. Pilots have been asked to land near end of the distance down the runway since the first of the subject airlines on takeoff has caused a substantial effect on the blacktop runway surface.

► Transcontinental S. A. of Argentina will begin American Express Company cargo for the purpose of transportation between the U.S. and South America.

► IBAE system, a British-developed visual glide path system of indicator lights, is being considered for adoption by Federal Aviation Agency Administrator E. R. Quisenberry. System consists of 12 light units which are arranged in two rows with three units on each side of the runway 750 ft from the threshold. Visual units 1,300 ft from the threshold. Lights are operable on a manual aid in night and low visibility landings. The system has been recommended by FAA's Bureau of Research and Development as a national standard.

► Federal Aviation Agency air route traffic control center last week began using 500 new radio frequency assignments for air route traffic control. An additional 100 frequency assignments will be added within the next 90 days.

## SHORTLINES

► American Eagle Air of Argentina has been accepted as a member of the International Air Transport Association. It is the 17th South American airline to join the international airline association. It operates Douglas DC-6B aircraft from Montevideo to Buenos Aires, Rosario, Lima, Peru, Santiago, Chile and Buenos Aires with intermediate stops.

► American Airlines scheduled to introduce the Boeing 720 subject transport July 11 on its Cleveland-St. Louis-Los Angeles route. The new aircraft, which will fly one daily round trip on the route, will carry 48 first and tourist class passengers.

► Eastern Air Lines placed to put the first of 19 Douglas DC-7B aircraft into service last week. The DC-7Bs were converted from an all-first class configuration which carried a total of 60 passengers instead of the present 75. The converted aircraft will eventually be used on services to 15 cities on Eastern's routes. Work on the aircraft now done at Eastern's Miami maintenance base.

► Kerosene Helicopter Corp. of Philadelphia has signed a two-year contract with an American company to provide aerial transport services in Bolivia. Kerosene will operate the service with two Fairchild C-41 transports. All maintenance will be performed in South America. Kerosene recently leased three planes and two mechanics for assignment to Bolivia, and air service is scheduled to begin this month.

► Pan American World Airways announced three additional Boeing 707 international (subject transport) to be used on round-the-world services. The 110.5 million order is scheduled for delivery early in 1962 and brings to 55 the number of subject transports Pan America has in operation or on order.

► Qantas Empire Airways plans to introduce a sixth weekly round trip Boeing 707 service between San Francisco and Sydney Sept. 1.

► Trans Caribbean Airways has received a six-month extension of its authority to operate flights from San Juan, Puerto Rico, to Aruba, Netherlands Antilles, from the Civil Aeronautics Board. The carrier has been flying two round trips a week for the past six months from New York to San Juan and on to Aruba. Pan American World Airways opposed the extension, and Royal West Indies Airline claims carrier diverted from the extension decision.

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Now, by flying Caravelles, airlines can provide pure jet service on many routes where the big jets are barred.

Not only does Caravelle have short runway requirements, but it can operate with minimum airport facilities. It carries its own built-in loading stairs and can start its twin-jet engines from its own airframe batteries.

Caravelle can fly profitably over routes from 200 to 1600 miles with as few as 18 passengers aboard. High rates of climb and descent plus jet speeds result in short block times.

It fits the Douglas tradition... dependable, durable, and an airline professional.

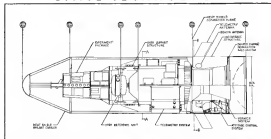


LANDING DISTANCE  
3500 FEET

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by SUD AVIATION

Sold and serviced  
by DOUGLAS AIRCRAFT





ATTITUDE-STABILIZED payload carrier for the 2-3-4 version of HETS 609A is drafted down. The Allegory Exhibit Laboratory 2-3-4 full stage motor can be replaced by mini payload in the three-stage configuration.

## Scout Variant to Have Dyna-Soar Role

By Russell Hawley

Newport News, Calif.—Missouri-based Air Force Hyperbolic-Ascent Test System (HETS) 609A, now beginning a series of new development flights from Cape Canaveral, Fla., is slated for an important role in the Dyna-Soar program and is a strong contender for at least three other important roles.

HETS 609A is a family of variants

of the National Aeronautics and Space Administration's Scout Offshoot of Ford Motor Co.'s Aeromaster. This new family of variants for various integration and payload carrier designs, told American Whittaker that a HETS 609A vehicle is intended to carry a 500-lb model of Dyna-Soar in an altitude of 180,000 ft and a speed of 20,000 ft/sec, west spring. Dyna-Soar model flights originally were planned

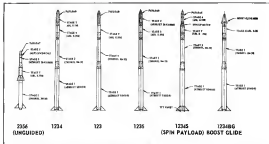
for this year but reportedly slipped about a half year because of some delayed decisions by Department of Defense.

Another group of between five and six development shots may be added to the now already scheduled. Some of these would involve "openness" test and research flights, scheduled to begin after the first of the year if the expected funding is received. Aeromaster officials say a total of 62 aeromaster HETS flights in 1961.

Three of the programs for which HETS 609A is competing are:

- **Maneuvering autonomy radio communication** role to back up strategic global communication system 484. Launched into a vertical or helix trajectory the role could be used to generate "Alpha effect," interference of nuclear blasts or detect enemy jamming during the crucial first hours of a war.
- **Lightweight version of Transit navigation** satellites now being considered in Navy.
- **Flight testing of Aero repeating short dog hole in a series of controlling re-entry trajectories.**

Scout planned HETS vehicles have been selected for feasibility tests of the inside-outside radio. Satellite communications may offer some of the same advantages as outside radio, plus longer life, but are more accessible to



SIX CONFIGURATIONS of HETS 609A. The base 2-3-4 configuration differs from NASA's Scout in having a 30-in-dia payload carrier rather than a 20-in. dia. The 2-3-4-5 configuration is nearly identical to Scout.

enemy countermeasures because of their fixed schedules.

Aeromaster officials believe that the recent statement of the Project Star line altitude communication satellite makes acceptance of the inside-outside radio system more probable. Defense Department officials apparently have been directed to Project Scout with a 75,000-mi, earth orbiting satellite, optional orbit without having satellite of lower capability. Realization of the latter plan is far enough away to improve the hopes for cheap, outer projects with some of the same advantages. Aeromaster engineers believe.

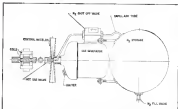
Agree effect of radiation upon communication is about in the low frequency commonly used for long range radio communications and is low in the high radio frequencies, becoming only moderate at ultra-high frequencies. These frequencies are seldom used for long range communications because they are limited to line-of-sight range. The inside radio would make these usable in operating at an altitude high enough to be within line-of-sight of earth, half the earth at apogee.

Positive control communication with Strategic Air Command bombers in flight is one important application of

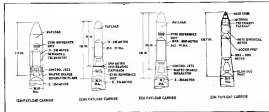
the inside communication system. The system would sense transmission of "go" orders to air alerted bombers at the outbreak of war. The inside radio probably would be fired into a worldwide ballistic trajectory with a westward altitude which might be as high as 7,000 mi. of HETS is used.

### Link Stations

In transonic communication, the HETS-based radio could link stations separated by a distance of 6,000 mi. for a 2.7-hr. period. Stations 5,500 mi. apart can communicate briefly when the radio



FOURTH STAGE two-level control system is pointed when in solid propellant gas generator or by compound nozzles exhausting through a pair of opposed nozzles. Fluctuating valve pulsations cool flow of hot gas to approach nozzle.



FOUR PAYLOAD CARRIERS of HETS 609A. A major difference between 2-3-4-5 (Scout) and the base 2-3-4 (standard) configuration is the movement of the Mannequin-Hawley gas reference and from the advantage structure which remains attached to Stage Three into the first stage.

Theoretical Concept  
is Turned into Hardware

## Honeywell Develops a Practical



Mr. Robert Mize, Chief Engineer of Honeywell's Marine System Group, is reflected in the highly polished beryllium spherical rotor of Honeywell's new Electrically Suspended Gyro. The Mize System Group is a special Honeywell unit devoted to guide the ESG program through its rapid development.

## Electrically Suspended Gyro!

Advanced new gyro concept using friction-free spherical rotor will bring greater accuracies to marine and airborne inertial systems, and northfinder systems.

Honeywell's leadership in the field of inertial systems and sensors is further demonstrated with advances in its Electrically Suspended Gyro. Now the company has taken a theoretically superior gyro concept, conceived by Dr. Arnold Nordmark of the Univ. of Illinois, and turned it into practical development hardware. This new ESG concept is being developed under funding from the Navy Special Program Office and Wright Air Development Division. Recognizing the unique capabilities of this new device, Honeywell has assigned a special task force group to coordinate the development of the gyro and the inertial system designed to take full advantage of the gyro's capabilities. In the near future, the Honeywell aerial system incorporating the ESG will be put into test phase.

This new gyro has only one moving part, a spherical rotor, electrically suspended in a self-contained, hard vacuum to completely isolate the sensing element. The spherical rotor is made of beryllium, machined and polished to tolerances of a few millionths of an inch! The gyro is brought up to speed by electronic means, then stays dead-against long periods of operation. Reference information is picked off optically.

Honeywell, because of its experience in gyro development and systems, has already solved many problems related to this new gyro concept.

### 1. Precision Machining of Problem Material:

In order to take advantage of beryllium's high material stability, Honeywell has developed manufacturing techniques that overcome beryllium's brittleness and toxicity problems.

### 2. Precision Coatings:

Honeywell has perfected the techniques for coating and machining the precision ceramic aeroloy, and for overcoming the difficulties in fabricating the ceramic-to-metal seals.

### 3. System Integration:

Honeywell, with its advanced system experience, has created a new inertial system to take full advantage of the capabilities of this new Electrically Suspended Gyro.

For more information on Honeywell's new products, write to Minneapolis-Honeywell, Dept. AW 7111, Minneapolis 8, Minn.

## Honeywell

 Military Products Group



Precision ceramic aeroloy rotor is held flat, clamped after being freed at a temperature of 1500° C. Diamond grinding and ultrasonic drilling are utilized in finishing the aeroloy.



Beryllium rotor, after being machined, ground and polished, is checked for spinning tolerances of a few millionths of an inch!

Collins 618T  
HF SSB  
Transceiver



The Collins design teams have developed global communication for the U.S. Air Force, Navy, and Marines are now introducing the 28,000 channel 616T HP 55B Transceiver to meet the increasing operational workload and for reliability in extended range air-to-ground communications. Covering the entire 8.30 megacycle band, the 616T offers both AM and SSB performance. Simplified air control operation selects any one of the 28,000 automatically tuned channels. Complete interoperability with existing military and commercial ground stations, both AM and SSB, is available for any mission.

The GWT is translated, completely modernized, including power supply. It's better, smaller — 1 kWh cost per

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 Higher digital-to-analog ratio  
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 Detachable speaker to lower impedance  
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 Complete transmitter in a 1 ACB case  
 FAA TC'd & Receiver certified in FCC

Available for August 1, 1993 delivery  
Write or call Calsol American Sales  
Center, Piquette, Iowa, for information  
and complete technical specifications.

COLLINS

[illegible]

Flight Date	HOFS Type	Mission
July, 1963	D-5-6	D-3 suspended probe to about 6,000 m; no altitude; complete vehicle spin-out below
July, 1963	D-1-5-6	D-3 suspended probe to about 10,000 m; altitude; vehicle near to D-1 but with full spin-out
Aug. 1963	1-5-6	D-3 probe; three stage high altitude probe
Sept. 1963	1-2-5-6	D-4 guided four stage probe with altitude; full spin-out
Oct. 1963	1-3-1-4	D-5 spin-out above
Oct. 1964	1-3-1-4	D-6 guided three stage altitude probe
Nov. 1964	1-3-1	D-7 unguided three stage probe; no altitude; vehicle. The recovery body will leave up before impact
Dec. 1963	1-3-1-5-6	D-8 orbital flight with spin-out/altitude first stage; vehicle is the same as NASA Sea-Bird spin-out above
Dec. 1963	1-2-5-6	

The HETS vehicle for the waste relay can be available by 1981. Aeronautics engineers in the new electronic technology is needed to build the relay.

about 300 watts. The ground stations must have a gain of 32 db, but this can be had with costing 60 ft parabolic tracking antennas. The station relay and relay-station links would each have a bandwidth of 1.5 m, accommodating 300 four-kilohertz duplex voice channels, which Acoustasonic engineers see as ample capacity to replace all current terrestrial communication systems.

Reaction time of the solid's EHTS vehicle can be less than five minutes. Its maximum acceleration would be less than 10g compared with 80g for some solid propellant rocket systems. This is a relatively simple load to deal with in the design of the electronics.

The five in HE78 development groups are to be high altitude probes the seventh is to be a partial recovery test in which the vehicle will burn up before impact and the last two will be orbital flights. The series of nine is to be finished by the end of the year. Almost 50 different experiments were approved and authorized by Air Research and Development Command for inclusion in the payloads of the development vehicles.

While development of the family of vehicles is the primary aim of the near-term effort, the greater part of payload will be devoted to experiments. This is possible because the majority of the basic HITS vehicle in the NASA Sonar enables USAF to use such NASA flight test data. Actually, more performance test instrumentation will be carried than was originally planned.

### Heavier Payload

Extra flight test instrumentation will make the first HETS payload twice as heavy as the otherwise identical second and are tentatively scheduled to go later this month. The extra weight reduces the maximum attainable altitude by a factor of five. The second one is to reach an altitude of more than 20,000

As a result, the program is likely to be canceled in the near future.

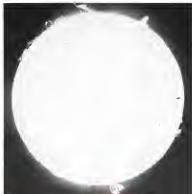
As a result, the program is likely to be canceled in the near future.

### Cognitive Biases

The survey turned up a need for a wider range of capabilities than that of Soviet ICBMs. The best way to obtain them and still achieve something like the first column of Soviet capabilities is to buy a new set of Soviet-style liquid-fuel boosters to include a larger number of stages, including an optional solid-fuel stage, the number of warhead carriers, and the number of warhead motors. In certain places, Soviet ICBMs show 80% higher ranges than the best ICBTs if they include a probe trajectory. An extended case exists for the fourth stage of MEITS designed to improve maximum altitude by 25% or payload by 100%.

- 4,000 **msd** of altitude for specified 100 lb payloads
- 10,000 **msd** ms for 35 lb payloads in the smaller unpowered and specified configurations
- Altitude of 3,500 **msd** for altitude

- Acropet General Brown-Algal
- Thiodol XM155 ET-Green
- Thiodol XM155-EI-Cactus (with sea level norm)
- Algalia Bacteria Laboratory: X214
- 45-Antennae
- Algalia Bacteria Laboratory: X214
- 42-Antennae (with thickened area)
- Algalia Bacteria Laboratory: X248
- 45-Antennae
- Algalia Bacteria Laboratory: X248
- 45-Antennae (with thickened area)
- Algalia: X250
- New Orleans: Test Station 100A
- 17-06 - Antennae (with solid model)



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Circle 10 on Reader Service Card



standard 100 lb payload. Their use, at present, is in terms of HETS being in standard stages and a variety of standard hardware. Inventory standard types are provided by Chance Vought Aircraft.

No reason has more than four stages or fewer than three, but new ones could be designed.

#### Rocket Uses

Each of the six rockets used in HETS stages is assigned a single digit identification.

The combination of digits identifies the mission and then:

- 1-2-3-4 is the basic two-stage HETS with an attitude stabilized final stage.
- 1-2-3-4-5 (Space) has a spin stabilized final stage and is identical to NASA Scout.
- 1-2-3 is a three-stage vehicle with the fourth stage motor replaced by more payload. Performance, however, is reduced.
- 1-2-3-5 is identical to 1-2-3-4 but with a separated bigger final stage motor for better performance or additional payload.
- 1-2-3-4-6G (Boost Glider) has the final stage replaced by the rocket-powered boost glider (Dyna-Sort) representative model.
- 1-2-3-5-4 is the four-stage separated attitude guide used in the first two flights. The first and second stages are the same motor as the second and third stages of the 1-2-3-4 HETS configuration.

The third motor payload, the final stage of the 1-2-3-4 rocket has been given a 30 in. diameter, compared with 20 in. for Scout and a performance penalty is paid.

In both in the big size version and the small of the boost glider model have made the surviving structures and the use of the third stage are limited by the use of the first stage. The base of the first stage has been fixed and the increased distance between the nozzle and the dim is used to hold the control action hand-off.

Stage One control is provided by magnetic acceleration for tip and no. 100 lb. mass in the first stage. The first and second stages are limited by their own weight. In Stage Two and Three, hydrogen peroxide nozzles, control pitch, roll and yaw.

#### Attitude Control

An unusual two-level attitude control is used in the final stage without spin stabilization. The high level control is used during the burning time of the final stage propellant motor to counter the relatively high accelerating torque produced by its thrust and the low level control is used after burnout. Both methods make use of eight small



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- Complete Hole Fill
- Positive Visual Inspection—After Installation

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**MANEUVERABLE SPACE VEHICLE** is shown at the General Electric store reception. The model features a vehicle in three sections: a pilot section, a payload section, and a propellant section. Note how the vehicle is designed to change its attitude plane by as much as 10 deg.

## Control Systems for Maneuverable Space Vehicles Are Investigated

Los Angeles—Aerodynamic methods of maneuvering during re-entry of a space vehicle add less weight than rocket maneuver systems if payloads are heavy or the amount of maneuvering required is large. L. W. Waisbrod of General Electric Co. reported at the summer meeting of the Institute of Astronautical Sciences, here.

For small maneuvers, Waisbrod found little to choose between the two techniques. He said that simple non-destructive systems doing with a few servomechanisms can be carried out in an early date.

The correct and most important was one involving a requirement for maneuverability, are these:

- Satellite response
- Retrieval and rescue
- Entry
- Space search
- Reconnaissance and patrol
- Satellite lift

Waisbrod said, "These missions are all similar in that they require moderate maneuvering, but probably be carried out at re-entry velocities, and will control of a single maneuvering system per flight. Because of the required characteristic velocity increments these missions could be performed from capsule hypocoers in free space of 10 deg. or less between trajectory planes. Velocity requirements of about 5,000 ft/sec (more than the initial velocity) will be required for supersonic maneuvering."

Search, reconnaissance and patrol missions may call for this ability, to make complete maneuvers, but a simple in-

tercept without changing the vehicle velocity of the two vehicles may be adequate for some of them. Waisbrod said it is quite likely that these missions will demand the ability to make large trajectory plane changes, possibly 45 deg. or more. The end it would be highly desirable to be able to make multiple maneuvers, perhaps 10 per flight or more. The vehicle requirements for these missions may be as high as 100,000 ft/sec and the velocities in at least 5,000 ft/sec. Because of the high requirements, these missions must await important advances in propulsion technology.

Satellite lift missions may be carried out with a simple intercept trajectory. One maneuver operation per flight and small trajectory plane changes in the terminal stage should be an adequate capability.

### Velocity Increments

Characteristic velocity increments for the lift mission will be less than 5,000 ft/sec, so it should be possible in the near future.

Waisbrod's assumptions in his space maneuver studies included altitude of 200 mi. as for the orbital vehicle with the maneuvering vehicle starting its operation from the upper of a ball-line trajectory in the path of the orbital vehicle. The initial relative angle is 10 to 30 deg. and the angle is more than the trajectory plane of the vehicle is 10 deg. or less. He found that the initial relative angle is not an important factor in any set of criteria studies.

## Recovery System To Slow Re-Entry Speed

Goodrich Aircraft Corp. has developed control fabric balloons which will be used to slow re-entry speed of recovery systems designed to control deceleration of re-entry vehicles (AW Jan 25 p 27). Called "Inflate," the system was developed by the Research and Development Center of Wright Air Development Division. They are to be used in initial landing and control speed of instrumented nose cones, manned cargo capsules and other orbital vehicles during re-entry through the earth's upper atmosphere. A parachute is ejected at lower altitudes to complete the recovery.

Spacecraft Control Unit controls will evaluate the recovery system data. One that will act as a vehicle of Mach 2 at an altitude of 150,000 ft and a second firing will be made to give Mach 2.5 at 100,000 ft. The balloons will be deployed and inflated behind the capsule. When the capsule is inflated, the balloons will be used to slow and control the flow region and, for maximum drag.

Wind tunnel tests of 15% scale models have been conducted at National Aeronautics and Space Administration facilities of Ames Research Center and Langley Research Center. Balloons inflated altitudes of 155,000 ft and speeds approaching Mach 3.5 simulating actual re-entry conditions and deployment conditions. The balloons will be able to maintain transverse and supersonic flow, according to GAC.

## Westinghouse Laboratory To Study Space Avionics

Westinghouse Electric's Air Arm Division will set up a new Avionics Laboratory at 4000 North Hollywood Blvd. in Los Angeles in the Century Plaza to develop avionics in aircraft and space vehicle systems, with occupancy of temporary quarters during phase three development and construction of a new facility scheduled for completion in March, 1963.

## Converter's Output Is 2½ Million Bits per Second

Amlogic Digital Corp. has developed a new converter for radioing music and speech data, with an output speed of 2½ million bits per second. It has been developed by Amlogic. Company's new converter is 50 times faster than any comparable unit on the market and that output speed can be increased to 10 million bits per second. Converter is suitable to wireless use half per cent of full scale.

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Practical solutions to the problems of extreme heat, the inherent enemy of electronics systems, are now available through the development of Refrigeration and Air Conditioning systems at American Electronics. Both liquid chiller systems and "air-to-air" cooling devices are a major part of the production at AE's Ground Support Division. These units, products of AE's specialists in air-conditioning for Ground Support applications, are precision-made, rugged, and completely reliable. All models of AE's liquid chillers and high volume, low-pressure air conditioners are air-transportable to meet your needs anywhere, any time, in any climate or geographic extreme to keep your electronics systems and components operating most efficiently.

*Photo credit: Air Force Ground Support Division*

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## AVIONICS



COCKPIT display for high-speed, long-range aircraft in current utilization, uses flat screen display produced by internal illumination of small transparent cathodoluminescent tubes. Spheres, continuously positioned by external navigation computer, show vehicle latitude, longitude and heading. Prototype model, made by Mitrop, is shown left with cutaway showing of device shown right.

## Moving Globe Displays Pilot Position

By Philip J. Kline

Washington-Norad cockpit displays for high speed aircraft, particularly useful for those operating in polar regions, as well as for command vehicles or space vehicles, have been developed by Mitrop and by International Electronic Machine Corp.

The devices developed by the two firms display vehicle position in true spherical coordinates on a small screen,

projected from a small transparent onto plastic globe, or hemisphere, which is continuously positioned by signals from an external navigation computer. The transparent globe is supported on a series of gimbals, gimbals which enable the display to show vehicle heading as well as its latitude and longitude. As adapted to space vehicles, the sphere or hemisphere could contain a stellar map of stars and planets.

Mitrop has constructed a fully oper-

ational prototype with a 10 in. sphere screen, which weighs 25 lb. including wire connections. With transparent anodized and a slightly smaller screen, the overall weight could be cut in half, according to project engineer Milton Gaidis.

IBM has not yet constructed a complete operating model, putting its current effort into developing techniques for housing the small glass globe to the required pressure and wire projections



SIMILAR approach is being investigated by International Electronic Machine Corp. for possible application in North American B-70 Mach 3 bomber. IBM uses hemisphere and an optical projection system, a slightly different technique from that of Mitrop. Group of hemisphere is shown right.

## THEY RELY ON RADIATION

for high-speed  
data processing systems



From active and test ranges near close to a foot of range, Radiation Electronics demonstrates that the data for commercial industry—from various kinds to the low range of digital computers. The test the test are used to Radiation Electronics by the Applied Physics Laboratory for the Hughes Aircraft Company.

The system, an analog and built by Radiation for AF, performs a number of sophisticated functions. It converts Pulse Code Modulation data from one form to the required for many into a digital computer; displays data/M and data/M/M analog laboratory data and records it on magnetic tape for easy into a digital computer; provides, with built-in display, read-out of up to 10 channels for dual-slit and dual-channel (display) before computer entry; provides high-speed multi-channel data to digital when from analog high computer output tapes or the same tapes; and allows tape-to-tape conversion of language (modulation of IBM tapes to IBM tapes or vice versa).

**RADIATION** is a leading in this project is a unique kind of value, required in the development of space-based data processor and display systems. If you are ever faced with projects in other fields of advanced electronics, it may be worth your while to know more about Radiation. Write for our latest Circulars Report to Radiation Incorporated, Dept. AF-1, 4400 Avenue Road.

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**RADIATION  
INCORPORATED**

option, according to the company's Fred Longwell. Development started about a year ago as part of IBM's contract to develop the built-in option system for the North American 370/150 Main Frame, but since the outbreak in the program, the company has turned on the globe display work with its own built-in option system. The first option development program, the first option, with company funds, was launched about 24 years ago, according to Collins.

Although IBM and Molnar are using the same device, their design approaches are somewhat different. IBM employs a hemispherical, rather than a sphere, and an optical projection system. Molnar has selected the geometric approach, requiring no optics, which employs a small point source. Longwell located in the center of the sphere to produce an image on the external screen.

### Scale Factor

By merely shifting the screen closer or further away, from the transparent globe it is possible to change the magnification. At such times, the Molnar unit uses a scale factor. The same model can provide the 1,000,000 scale of an navigation (N-N) astronomical chart or the 1,000,000 scale of global navigation charts (GNC).

In the Molnar prototype, the 18 x 18 in. screen provides an area roughly 5 in. in diameter which has acceptable definition of the corresponding image. Because the image is being projected from a spherical surface to a flat screen, there is inherent distortion of distances as one moves out from the center of the screen—which point corresponds to the vehicle's present position. Here, then, there is no regular distortion.

For a scale factor such that the screen is displaying at an area roughly 2,500 in. in radius, there will be no appreciable distance distortion for a radius equivalent to about 600 m from the center of the screen.

A plastic eyepiece can be placed directly in front of the screen so the pilot or navigator can just see desired track or targets in precise point.

### Display Detail

The feasibility of the spherical projection display concept hinges on the question of whether a small glass globe could be fabricated with the required orthographic detail and precision. Molnar set as its goal the achievement of the same amount of detail which is contained on existing (N-N) (jet navigation) series of astronomical charts, which have a scale of 1,000,000. In terms of the 5 in. diameter glass sphere which Molnar set, this amounts to a resolution of 1/60,000,000.

This objective has been achieved both by Molnar and by the USAF's

# hma

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## A3J—the most versatile Mach 2 airplane in the world today

Probing the horizons of the Free World, hovering on the fringes of tension areas, bolstering the cause of world peace by its mere presence in the sky—this is the job for the Navy's new A3J Vigilante.

Designed and built by the Columbus Division of North American Aviation, the A3J has a versatility unmatched by any other Mach 2 airplane in the skies today. It is equipped to handle a variety of nuclear or conventional weapons for either limited or all-out nuclear war. It has the speed and maneuverability to fly single-plane attack missions with out fighter escort.

The Vigilante can fly through the stratosphere faster than the sound barrier itself, yet can throttle down to subsonic landing speeds for carrier decks—or small field runways. It is also suitable for prompt response recon missions that make it ideally suited for low-level missions over irregular terrain. Its speed and maneuverability plus the most advanced fire control systems known make it a single airplane with an outstanding dual capability—high-performance attack or long-range interception.

The A3J Vigilante truly is a significant addition to the U.S. arsenal dedicated to preserving world peace.

**THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.**

Columbus, Ohio



Accommodated Chart and Information Center at St. Louis, Mo., (which prepares astronomical charts) each using different processes, according to Golda.

The Air Force facility itself has developed two techniques for making the catoptronic spheres. In one, precision glass made of optical quality glass is coated with a photoresistive substance, then exposed to a master globe using a point source lamp. Finally developing processes are then employed to fix the image on the globe.

A more recent USAF technique employs the sheet of plastic sheet 0.01 in. thick upon which the catoptronic image is printed by photo process, after which the photo sheet is heated and blown into a spherical shape. The catoptronic image is exactly distorted when printed on the flat sheet so that it will compensate for distortion of the sheet that takes place during the blowing process.

The catoptronic spheres can be painted with black-and-white or color images, depending upon the operational requirements.

Golda's technique resembles the film of the Air Force technique, except that the company uses a screen of photo-optical emulsion to produce the original master globe. After that the photo process for making production units are identical.

Because chart making is the St. Louis facility's main activity, Golda probably would prefer to obtain the globes from the Air Force chart center rather than produce the units themselves. Golda indicates.

The USAF chart facility now is able to produce these globes with the same degree of precision and accuracy as standard astronomical charts, Golda says.



### Collins Transceiver

New ultra-high speed high-frequency radio transceiver, which also provides conventional AM operation, offers 26,000 channels in the 230 mc. band in 1 hr. setup. New Collins Radio 610T transceiver, which delivers 400 watts peak envelope power on single sideband or 100 watt carrier on non-restricted AM, weighs 47 lb. and occupies a 1 ATR size case. First units become available in August.

## On Target, Because...

*B&L optical-electronic-mechanical capabilities help align azimuth on Polaris Submarines*

To sharpen the shooting eye of this deadly fish, Bausch & Lomb developed four different instrument systems to convey optical and electronic information between the missile guidance package and the inertial navigation system.

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**Highway, skyway or byway, Hawk gets there fast**—The Army's extremely mobile air defense weapon, for which Raytheon Company is prime contractor, has also been adopted for use by the U. S. Marine Corps. Tree-top attackers are Hawk's special quarry. It uses a solid fuel propellant, and can accompany fast-moving field forces. All eleven units in the Hawk system can be transported by standard military cargo aircraft and by helicopter, rolled over the highways or over the roughest terrain. The equipment is lean and rugged, skillfully designed with carbon, high strength, and alloy steels—available from United States Steel. When your missile support system goes on

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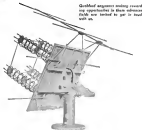


## antenna systems capability

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Reeves has over ten years of distinguished experience in the sophisticated design and development of two and three axis antenna systems and their related terms, radar and computer instrumentation. Currently actively engaged in the DISCOVERER and PROBE/2000 programs, Reeves has produced antenna systems for the T-28 and RADAR programs, as well as a wide range of mounts for other missile tracking and guidance applications.

If your projects involve development of advanced antenna structural equipment and fixtures for search, tracking, guidance or control, it will be worth your while to contact Reeves.



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position and rate information. This is processed by the computer subsystem which provides command and firing information to other subsystems.

Subsequently, the armament subsystem performs the DAVIS weapon simulator by tuning it to the correct radar bearing frequency, positioning the stage gun over the target and setting aerodynamic parameters for proper flight in the DAVIS simulated environment.

At firing time approaches, the armament door opens, and the weapon simulator is extended on receipt of the computer-generated firing signal. In DAVIS Approach and evasion data are computed and displayed on the DAVIS screen. A direct hit, in-range result at the weapon simulator indicates if weapon was properly prepared.

Anticipated errors are automatically evaluated. RCA indicates, by measuring the steering error and the time at which the weapon simulator is fired.

Then some operating procedures can be repeated for other simulated attacks and other launching tasks. Total time for the complete DAVIS check is 12 min., RCA says, which includes connect, set up, warmup, test and disconnect times. A step-by-step manual checklist of the system requires 34 hr.

If the armament was damaged in within allowable limits, the weapon is regarded as operational. Should the war indication fail to fall within these limits, however, DAVIS can and is monitoring the fault during troubleshooting, the company says. Because DAVIS is a through-the-loop test, it is used to help locate many types of system faults and can be used in static testing of the control system.

Incorporated in DAVIS is a self-test capability removing of confidence checks and alignment tests. Confusion checks usually require operating status of DAVIS before use and the alignment tests are run periodically. As indicated, self-testing is performed during weapon system warmup time.

To use typical self-test method-and employed for the area distance comparison—third error is inserted in the approach and evasion error channels and a fixed firing signal is the test of linear non-perturb. After computer processing, the results are read of the error indicating status and compared with known values to see if the computer is operating properly. The self-test equipment is relieved to provide components such as a quartz delay line to ensure minimum possible reliability.

A mechanical potentiometer was designed into DAVIS to give accuracy and repeatability, according to RCA. Adaptation of DAVIS for systems other than the F-102 weapon control system would not be complexly from a single

case change for a similar type of weapon system. Fixed target range accuracy of the test computer is said to be within 10 yd plus or minus 1 of 15.

## Flight Monitor Gives Pilot Audio Warning

Automatic monitoring and audible warning of 12 potentially hazardous flight conditions is provided by a so-called-developed acoustic recorder to supplement warning lights and various pilot machine instruments. Developed by the Research Division of Northrop Corp., the

voice warning system can monitor flight parameters, engine instruments and aircraft configurations, plus payload and prelanding check lists, etc.

The Northern voice warning system is set to operate upon activation by means of aircraft conditions such as exhaust gas temperatures, low fuel pressure, landing gear or flap position, alternator or generator condition, or any combination of undesirable flight parameters. A preselected message is fed into the pilot's headset or through a loudspeaker system to warn the pilot of a given flight departure condition and instruct him of the required action.

Until the condition is corrected, or

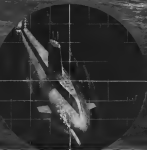


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## The challenge of silence

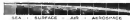
The wide and deep sea is a near-perfect hiding place . . . and an infinitely mobile launchpad pod. This makes submarine warfare a high-priority defense problem.

Not just the sea, but the surface and the air as well, comprise the theater of ASW. And in all these areas Sperry is making advanced counterburial systems: passive sonar detection gear . . . automatic fire control systems . . . automatic depth and maneuvering controls . . . countermeasures and counterintelligence systems . . . sophisticated navigational computers for helicopters, capable of programming a systematically precise sub search . . . automatic flight controls for the helicopter to permit it to do its job despite the vagaries of weather or man-

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OUTLET shows contacts with 12 channels. Space is reserved for 10 more.

until the pilot manually deactivates the system, messages will be repeated. Should a condition of higher priority occur while a message is being transmitted, the device has a logic circuit to interrupt the lower priority message. The voice warning system has been evaluated in two Cessna 441B Skylanes by crews of the Joint Test Tank Force at Cannon AFB Tex. with the result that a recommendation was sent forward suggesting that the system be incorporated in all of the Mach 2 landings scheduled for the Strategic Air Command uncertainty. Indications are that it is of particular value in single pilot aircraft where the pilot can necessarily concentrate on one set of flight conditions to the exclusion of other details.

A typical example would be an actual weather instrument approach during which a pilot would find it necessary to divert his attention almost exclusively to the flight instruments and be unable as thoroughly to monitor important engine instruments.

Although up to 15 sets, in length, may be programmed and can be used to recognize:

- Portside pilot status checks
- Cockpit procedure training sequences.
- Messages to crew members and passengers.
- Flight test programs.

The unit uses 12 vid. a. current and draws 2 amp. when in operation. There is no current drain while in standby. It weighs 4.5 lb. and measures 4 1/2 x 4 1/2 x 9 1/2 in.

A test and recording module is available to record messages, which, may be taken through microphone or speaker, and test operation of logic circuit. Complete test of the voice warning circuit is made with the test and recording module without removing the unit from the aircraft. All that is required is to replace the playback cable from the system with a cable from the test module.



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PARA-VISUAL light attitude indicator is mounted for pilot and copilot positions in a de Havilland Doves, using three displays.

## Pilot Aid Designed for Automatic Landing

By John Tunstall

London-Newly developed cockpit visual indicators may substantially improve the use of automatic descent landing in the de Havilland DH112 jet transport along with lowering of flight minimums.

New concept, called Para-Visual Display (PVD), was developed by South Aircraft Instruments, Ltd.

It leads flight attitude information to the pilot when he is looking outside the cockpit—black and white stripes move directionally along the area of suitably oriented display tubes, in accordance with computed bank and pitch error signals supplied by a conventional flight director.

To tell the signals the pilot corrects the control column in the direction of the moving pattern. The display is so positioned with regard to the pilot's head that although his field of vision is outside the cockpit, the display is still visible within his enhanced peripheral perception. It means that the pilot can see the flight director signals during taxiway when running for runway lights in a 90 deg. arc ahead.

### Pilot Opinion

Since the first measurement of the PVD display technique at the International Air Transport Association conference at Luton last year, South Instruments Division has been conducting extensive flight demonstrations for pilots, airline officials and controllers in facilities. Pilot opinion so far, A.M.A. Heywood, director of operational requirements, said, has been favorable.

Another advantage of the display, said in several flight instructions, which have brought favorable pilot comment is the fact that the moving character of the display appears to offer the pilot a variety control of the aircraft's attitude. This coverage within the first few moments of flight a superior flight reaction which is both relaxed and instantaneous.

These changes of the display units, for less errors and production of the unit and a number of coupling units to suit various flight director has been final and by the time units are available next year, South expect to have established excellent reliability data.

The basic design has been optimized for the DH-112 which will enter service with a South display subunit and with the PVD display in a fixed independent control channel.

The PVD display units can be coupled to any flight control and used:

- In assembly, to hold a heading, to intercept and maintain the center of an ILS beam.

- In pitch, to hold the aircraft about a pitch datum and automatically to couple into and maintain the center of an ILS glide path. It also can provide VOR coupling in accuracy and height.

### VTOL Uses

The system is being adapted for VTOL aircraft and for helicopters. In the latter, one display is directed to enter gun.

In conjunction with the British blind landing system under development by the Blind Landing Experimental Unit of the Royal Aircraft Establishment, the display have been



COPIAT and slides "teaser pilot" cylinder viewed through a dot, stripes indicate direction.

AVIATION WEEK, July 15, 1960





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The PAT System is a highly responsive jet reaction control which controls the flight path, the position and attitude of a space vehicle as a result of intelligence inputs from the vehicle guidance system or ground control. The system is capable of providing the necessary corrective action based on the sample position and velocity error signals or will respond to the demand of complex guidance computers in the system. The thrust level can be adjusted over a range of 3500 to one (or more in some cases) with the same set of rocket nozzles; proportional control of thrust from 0 to full thrust is possible. Impulse imparted to the vehicle can be controlled accurately over a wide range down to a few milli-seconds in duration—with a one lb. thrust nozzle as low as

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Marquardt's fifteen years of research, development and production has resulted in state-of-art advancements in a wide range of electronic, electro-mechanical, pneumatic and hydraulic controls and accessories. For example, a pneumatic servo actuator is now available for 1000°F service—and severe nuclear radiation environments.

For additional information concerning the PAT-C System or other C & A specialties, contact Dick Ollinger, Chief Applications Engineer—Controls and Accessories, The Marquardt Corporation.

Engineers and Scientists experienced in these or related fields will find it rewarding to discuss their career futures with Marquardt. Founded in 1944, Marquardt now has a staff of 2,000—two out of three are professional people. The company's growth is a parallel to the atmosphere of challenge and rewarding accomplishment that has existed since the firm's beginning.

Shown in photograph below—Marquardt engineers discuss a full scale mock-up of a complete self-contained PAT-C unit designed for application to space vehicles.



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\* POSITION—ATTITUDE—TRAJECTORY CONTROL SYSTEM



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## KAZAKOV AND HIS 'KATZE'

The startled German couldn't believe their eyes. Below them, trailing a three-pronged anchor and an iron ball, was a Russian pilot in a Morane scout. Before they could get away, the Russians struck from above and behind, swinging the anchor on its steel cable. As he turned, it hooked into the left wing of their two-seater Alliotux. For a moment, the two planes were locked in combat, then the cable tore loose and the iron ball completely shattered the wing. The Alliotux collapsed and fell. Staff-Captain Alexander A. Kazakov, using a weapon unique

in the history of aerial fighting, had scored another victory on the Russian Front. It was June, 1915.

The anchor or "katze" was part of an experiment that had interested Kazakov during his days at the Sevastopol Flying School, founded by the Grand Duke Alexander to train pilots for the Imperial Russian Air Service. To the kate, an old form of German battering ram, Kazakov added a medium-sized iron ball weighing about 30 pounds, which acted like a sucker above a fish hook.

It was Kazakov's last experiment with an armed weapon, but it was not his last aerial adventure. Before his career ended, Kazakov had scored 22 kills. He held every known Russian decoration for gallantry, received the French Croix de Guerre and served as a major in the British Army, which awarded him the Distinguished Service Order.

The plane Kazakov used in his latest attack was a French-built Morane-Saulnier scout, a wire-braced, mid-wing monoplane that first saw military service in 1914, principally with the French and British. It was powered by an 80-hp. Le Rhone engine in a maximum speed of only 78 mph. Fitted with a 110-hp. Le Rhone in 1915, the Morane reached a top speed of 100 mph.



Staff-Captain Alexander A. Kazakov, first Russian pilot to use the katze in August, 1915, but quickly transferred to the air service.

In the spring of 1916 Kazakov was named to command Russia's 19th Squadron, the famed "death or glory" squad now based on the Central Front. The 19th, used as a shock unit, provided von Richthofen's "Flying Circus" by nearly a year.

With revolution rife in his country and an armistice signed between the Central Powers and Bolshevik Russia, Kazakov and several other Russian war pilots joined the Sino-British aviation group in 1917 to fight against the Bolsheviks.

When the Allied forces withdrew from Manchuria in the summer of 1919, Kazakov turned down a post in London to remain with his squadron. He and two comrades decided to join the White Russian army in Siberia, and on August 1 took off from Berzansk Aerodrome. His Sopwith Camel collapsed in mid-air and Russia's leading ace was killed instantly.

### Heritage of the Air

One of the most inspiring chapters in the history of technical evolution is the story of the man and flying machines of World War I. It is the highly personal history of brave men—and the wind, wire, linen and rudimentary technologies that set—and surpassed—records. Today, Leach Corporation celebrates its 50th year in electronics with the presentation of the Heritage of the Air series.

Technical Director for Heritage of the Air is Major Kenneth S. Brown, USAF.

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that means the same thing**

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**before it became "reliability"**

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Repeated use has debilitated the word by eroding its meaning. In short, "reliability" is worn out, the victim of overexposure. If you doubt it, count the number of times the word is used between the covers of this magazine.

What can be done about it?

That's a problem for the wordsmiths. Ours haven't been able to come up with anything that means what "reliability" used to mean.

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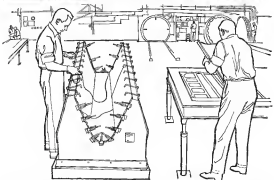
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## 1971 FILTER CENTER 20223

Deposited Components Improved—Bell Telephone Laboratories has refined its process for making deposited thin-film electronic components and controls for aerospace use to the point where values can be fabricated with a tolerance of 0.5%, BTL's R. W. Berry and Nelson Schwartz reported during recent Military Electronics Convention in Washington. Capacitors are treated to desired value by cutting off a tab on one electrode. Resistors are formed by an etching process which shows promise of achieving tolerances of 0.1%. The thin-film conductors resistors exhibit good temperature stability with less than 0.5% change in resistance after 1,000 hr exposure to 100°C temperature. Thin film capacitors have a temperature coefficient of 250 parts per degree centigrade and have a dielectric factor of 0.01 at 1 Hz.

New Tube for Space Electronics—Lightweight, long-life, low-voltage tube amplifier oscillators, specifically designed for use in space vehicles, is being developed by Watkins-Johnson Co., Palo Alto, Calif., under Wright Air Development Division sponsorship. New "TW" will operate at the 2,500 to 2,600 mc band deliver 10-15 watts power with an efficiency of 30%, according to a paper presented by H. K. Johnson and R. A. Roberts at the Military Electronics Convention. The tube, which employs electrostatic focusing, will weigh less than 1 lb and can be voltage biased over a frequency of 50 mc. Tube life is expected to exceed 50,000 hr.

Microelectronic Computer—Digital computer using microelectronic technology which Texas Instruments is developing for Wright Air Development Division, slated for delivery in mid-1968, is expected to measure only 4 x 4 x 1 in. in size. Program is sponsored by WADD's Electronic Technology Laboratory (AWT Lab, p. 79).

Subminiature Centimeter-Sperry Gyroscopic Co. will begin experiments shortly leading to the development of a subminiature wave focused 100-kilohertz electrostatic generator for Wright Air Development Division under a \$76,500 contract.

Delta Decacurves Navy Computer—A digital computer that is now in the rear of the world was demonstrated by Delta during the recent Military Electronics Convention in Washington. The device occupies a volume the size of "jet" or "jet" engines of the

## The Hours Here Are The Most Critical

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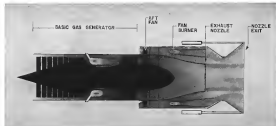
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FAN BURNER engine being studied by General Electric for supersonic transports is shown above. Fan section is coupled aerodynamically to gas generator at about the same point as the B-70. Fan section consists of single-stage fan compressor, burner, exhaust mixer and nozzle. Fan burner engine being studied by other manufacturers includes free fan types.

## Fan Burner Dominates Supersonic Designs

By J. S. Rutz

Washington—New class of high performance turbojet engines—the fan burner—has become the primary power plant choice for supersonic transports by most government industrial contractors and U.S. engine and airframe contractors.

Major U.S. engine companies are reexamining a large portion of their advanced design effort on fan burner engine designs to meet increasingly detailed performance requirements coming from Federal Aviation Agency, National Aeronautics and Space Administration and airframe contractor studies of supersonic transport configurations.

Supersonic fan burner turbojet physically will resemble the subsonic fan engines which will soon enter military and commercial service, except that they will have a combustor section in the stream of air going through the fan as well as in the high pressure flow in the basic gas generator. The burner section can be added to the fan flow on both the aft fan and the front fan types of engines.

Even though fan burner engines will be largely on paper they are regarded as superior to other types of turbojets for commercial use at supersonic speeds, primarily because of their relatively low operating temperatures and the very wide range of power they can deliver efficiently. Low operating temperature keeps noise low and parts life high,

while the wide range of available power is considered a safety and economic advantage on the supersonic transport.

Fan burner was previously considered so viable without the existing strategic threat that they will not require any more time to develop than the supersonic transport airframe, reversing the usual pattern in which the engine has been the longest lead time item on an aircraft.

### New Engine Interest

Interest in a new type of turbojet engine has developed largely because studies have shown that all currently used configurations of turbojets are marginal economically if their capabilities were extended for use as a supersonic transport. Engineers earlier to the General Electric B-70 considered turbojet under development for continuous cruise at Mach 3.0 to the North American B-70 bomber can perform the supersonic transport mission, but apparently not as cheaply as the fan burner turbojet engines now under discussion.

Another surprise behind the development of the fan burner is the progress of ducted fan technology in the past few years, which has significantly increased the designer's latitude in trying gas turbine engines in a great set of requirements.

Engine performance requirements for supersonic transports, which also inspired the search for a new type of

turbojet cycle, are more demanding than those of the past. In general terms, the requirements are:

- Noise at takeoff must be within the limits prescribed now as most airports near Airframe and engine companies and government agencies were agreed on this design objective. There appears to be no hope of suppressing the noise of a large supersonic turbojet to civil requirements without an unacceptable penalty in takeoff performance. Studies show that large fan burner engines can be kept within the civil noise requirement if they take off with little or no burning in the fan section so that fan flow temperatures are kept low and only a small percentage of the available energy is used.

- Fuelable limit of less engines to an aircraft, with a maximum of six, to keep initial powerplant investment and engine maintenance costs in line with those of larger subsonic jet transports. Thrust rating of these engines will be 30,000 to 40,000 lb without any burning in the fan section. Passenger loads for the aircraft would be as the neighborhood of 100.
- Supersonic transport must be able to complete a takeoff at one engine failure. Fan burner engines should be ideal for this requirement because in most cases, their thrust can be easily doubled when maximum burning is used in the fan section. Under normal conditions, the aircraft would take off with no burn-

ing or very little burning in the fan section to start the take-off requirement of one engine failure. The movement of only one engine will provide maximum fan section burning in the operating engine. The response to this fan burner burning would be almost instantaneous, and the engines can be used so that the cost which are running cost, thus making for the thrust of the dual engine. High noise level accompanying the auxiliary burning would then occur only during emergencies.

- Acceleration to cruise speed probably will be made with full fan section burning after the aircraft has climbed above 15,000 ft at normal takeoff power and subsonic speed so that engine and shockwave noise will not be objectionable on the ground. Use of very high power to provide rapid acceleration to cruise speed usually improves the range on one supersonic flight.

- Low specific fuel consumption is required at cruise speed. Fan burner engines possibly have the best fuel consumption of any type of turbojet using either or dual burning if the burning in the fan section is limited to only a small percentage of the maximum level. Fan burner will be aimed to provide the thrust required at cruise with little or no burning in the fan section. They would then combine good fuel consumption with high available thrust at takeoff and during climb and accelerate. Straight turbojet engines have better fuel consumption, but they become extremely heavy at thrust ratings approaching 35,000 lb.

- Good fuel consumption during cruise will depend on the duration and descent holding or diversion flight is one of the facts in developing a world supersonic transport. Even a few minutes of operation at low altitude and subsonic speeds requires enough fuel to make the whole idea of a supersonic transoceanic transport marginal. Fuel load is so critical to the capacity of supersonic transport design now being studied that some fuel cannot be left for diversion operations under present regulations and must be paid for by eliminating power plants.

The FAA stands in reexamining the possibility of lowering operating fuel requirements for supersonic transports if improved flight control and landing equipment and procedures prove satisfactory. The goal is to allow a pilot to obtain landing clearance at his destination at the same time that he gets takeoff clearance. Fan burner engine with a high fuel pressure rise in the compressor of its basic gas generator is the most efficient supersonic engine for subsonic, low altitude flight if it does not burning in the fan section.

Minimum operating temperatures in the fan burner engine will be about the same as those in current operating

turbojet engines, with 1,800° probably a maximum. Their overhead costs are expected to be comparable.

Temperatures in a large supersonic turbojet engine are much higher, and a considerable operational and development period is forecast before the speed between overhead and parts life for these engines will become acceptable within the current economic framework.

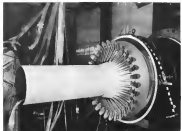
### Military Potential

Current turbojet design activity on the supersonic transport program has shown that fan burner engines have great military potential above Mach 3.0 if the U.S. decides to pursue the devel-

opment of high performance manned aircraft, thus the need for greater lift to offset the weight of the B-70 and cruise continuously at supersonic speeds. Studies indicate that they will be powered by fan burner engines.

The P-11 engine in the B-70 can be fitted with a fan burner section instead of an afterburner. Based on the power requirement which already has been achieved by adding fan sections to basic turbojet engines, this redesign of components could at least double the thrust of the P-11. It might be possible to duplicate two of the six B-70 engines of such a fan burner engine was available.

The primary penalty paid for the in-



EXPERIMENTAL work on components for the burner engine has been in progress for some time. GE exhaust mixer is shown in test rig above which is instrumented to show the mixer's efficiency in reducing two gas streams. Drawing of other types mixer, which would be extended nozzle supersonic, is shown below.





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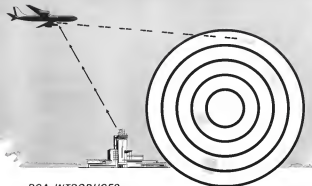
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COMPRESSOR for the fan shown on a fan burner engine is shown in the left portion of the experimental test stand shown. Compressor was tested by GE in 1976 over full range of operating conditions for a fan burner engine suitable for use on a Mach 3 transport.

overall performance is greater engine diameter. The fan burner engine will be lighter than a full afterburning turbojet to produce a given level of thrust at cruise conditions of burning so the fan engine is kept low. The fan burner also will have lower specific fuel consumption, less and will provide greater thrust thrust.

### Detail Design

A few detail design features of a fan burner engine will be peculiar to it, but most every will be common to all types of supersonic turbojets. A general description of the components of a fan burner engine, based primarily on studies by the General Electric Co., follows:

• **Inlet/Exhaust:** All types of supersonic ducted fan engines probably will have only one inlet for fan air and one exhaust for main gas generator air. Others have two inlets so that the fan exhaust and the gas generator exhaust can often then have left the engine.

Such installations will be subject to supersonic engine losses considerable greater will be required on all inlet and exhaust nozzles to achieve adequate performance. To reduce the weight and complexity of variable geometry mechanisms, all fan burner engines are probably will enter in one inlet and be exhausted on a common nozzle. But the simplicity in variable geometry installations is possible through combining the inlet or exhaust nozzles for second engines. Two inlets are used on the B-76 to feed air to six engines.

• **Compressor:** Compressor design requirements are not stringent compared with those on the high performance engines now flying. Some designers say the compressor could be built with 100% efficiency and no problems. The compressor ratio will be moderate,

probably in the range of four to eight. Pressure ratio in each stage will be low so that the compressor probably will have 9 to 12 stages. Current high performance engines operate with compression ratios around 13 and have 17 and more compression stages.

Only a moderate engine compression ratio is needed on the supersonic engine turbojet because the main pressure ratio is the inlet is high. The determining design consideration probably will be to provide enough compression within the engine to give adequate fuel consumption at subsonic speeds.

Another design consideration of the supersonic engine is that its turbine diameter is fixed by its large exhaust nozzle. This achieves the compressor design requirement of current engines, which call for small frontal area and low hub-to-tip ratio, which blades must be long and highly loaded to get sufficient air flow at minimum speeds. The supersonic fan burner compressor will have a large frontal area with a large hub and relatively short, lightly-loaded blades.

### Critical Problem

One of the most critical design problems with the compressor on supersonic engines is a low efficiency still margin which results from the flow distortion common in all types of supersonic engines when they operate even at a small angle of attack. When flow distortion exists one side of the engine must accept a greater mass of air than the other and there is an unequal pressure distribution at the compressor face.

General Electric is considering two methods of reducing the effects of inlet flow distortion. One is low blade loadings on the early and middle compressor stages and the other is variable compression geometry in the form of variable section stators. Low blade loadings help damp out pressure fluctuations and variable stator can be tied into the inlet

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## Thermoid-Quaker Jet-Starter Hose good as new after 3,500 starts"

says Mr. B. V. Darnes, Mach. Dept. Pan American World Airways.

Jet-starter hose has to take unusual abuse: transmit hot air up to 500°F at up to 600 MPH under sub zero conditions... withstand dragging over abrasive surfaces. Yet it must be lightweight and flexible... easy to handle and end on the correct mark for storage—and it can't kink, collapse or burst.

Thermoid Quaker Jet-Starter Hose meets these "impossible" specifications and has proved it can take that load of abuse with Pan American World Airways and the U. S. Air Force. According to Mr. B. V. Darnes of PanAm, their previous hose became unserviceable after only 1200 to 1400 starts. Thermoid Quaker hose has already outlasted the former hose by three to one and looks like new.

Economical service like this is extremely important to both commercial and military jet operations. In fact, this Thermoid-Quaker "Dacron" and Silicone rubber jet starter hose was developed for military use, and is used by the government. "Dacron" comes from construction materials the best quality, neoprene/limestone, and the silicone rubber is made by tube and bending long and fast and provide flexibility under low temperatures.

Get complete information, including Technical Data, on Thermoid Quaker Jet Starter Hose from your Thermoid Division industrial distributor, or write Thermoid Division, H. K. Porter Company, Inc., 300 Pleasant Road, Teaneck, N. J. 07666.

THE THERMOID DIVISION

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and for any variable geometry or automatic control system.

Plug needles for turbojets have been under development for some time by many engine companies. The only operational plug needle today is on the Pratt & Whitney J52 installation on the North American Blood Dog missile.

Performance of the plug needle has proven to be competitive with the variable geometry concept of design and cost.

They will provide roughly the same thrust coefficient under most flight conditions. The plug needle is lighter because it does not need a mechanical mechanism to change its dimensions. Its main disadvantage is a more stringent coating requirement because the plug is located inside of the exhaust stream.

The greater number of engine operating variables characteristic of its burner engine makes analysis of them somewhat more difficult than for current turbojets but at the same time provides some ways to do the same job. A typical paper engine designed by GE to meet the requirements of a Mach 3.0 commercial transport would have the following percentages of its total gross produced by its fan section and gas generator—doing its level takeoff with out burning in the fan section, the gas generator would produce 55% of the exhaust energy and the steam 45%. These percentages would be reversed during maximum acceleration and climb when fan burning was on. At Mach 7.0 cruise with life or no fan burning the fan section would account for 60% of the exhaust energy.

### Hope Reduced

The facility with which the operating parameters of the fan burner engine can be varied has caused some hope among powerplant engineers that it can be used to ease the very difficult job of designing supersonic inlets. In this respect it may prove possible to largely overcome the air spilling problem when the extreme or critical area of a supersonic inlet remains fixed over a wide Mach number range.

The air spillage cannot high drag so that some of the excess air must be vented and one excess air must be dumped efficiently at some location distal of the inlet. The hope is that the thrust of the fan burner turbojet can be kept constant while the total air flow through the engine is varied by changing the proportions of air produced in the fan section and the main gas generator. If this can be done the complexity of the inlet's variable geometry mechanism can be reduced by keeping the critical area constant and only varying the bleed area.



## General Electric can solve your special heating problems

Whether your thermal conditioning problem, General Electric can design and build specialty heating products with a high degree of reliability. Here are good reasons why.

**GENERAL ELECTRIC EXPERIENCE** in specialty heating dates from World War II, when we fabricated such items as heated flying suits and engine covers. We now produce reliable heating equipment for the sophisticated requirements of today's aircraft and missiles. Some examples: we are currently working on products designed to thermally condition propellers, heaters, electronic components, hydraulic systems, and turbine engines. And these products can be modified or tailored to any shape desired.

**UP-TO-DATE MATERIALS**, coupled with our extensive design and fabrication experience, enable us to build durable, lightweight heaters that will withstand severe vibration or shock. These materials are flexible over a wide range of temperatures, and possess a high degree of resistance

to water, oil, acid chemicals. The illustration demonstrates the molding of a high temperature plastic material.

**FOR MORE INFORMATION**, contact D. B. Hartout, Manager-Engineering, Specialty Heating Products Section, General Electric Co., Cincinnati, N. Y. (Phone Cincinnati 6-5531), or mail coupon.

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## Ferranti Developing Radar Fire Control System for Foreign Jets

Aspans II, a radar fire control system being specified for export versions of the Sud Aviation, Dassault Mirage 3 and English Electric Lightning is currently in development.

Based on the original Aspans, part of the Lightning F1B weapon system, the development is being financed by Ferranti, Ltd., Edinburgh in a private contract. Such has already specified Aspans II as standard for its advanced Descent for the Royal Swedish Air Force.

Major reason for the development of foreign interest is a fire control system with a "ground mode" form of operation, permitting the use of the equipment against ground targets and as a low-flight navigation aid. Mapping and terrain clearance features are built into the new system.

Ferranti goal was to increase the versatility of the lightning system without making it appreciably larger or heavier. Aspans system developed for the English Electric Lightning is a single package carried inside the vehicle "belly" area of the plane. The ground radar mode also is the same as the system to force the radar search more beyond the distance in the forward direction which limits all the rest of the aircraft equipment associated with the system except for the light itself and the pilot's controls for the sight.

Design objective for the system was to meet attack of conventional weapons. In addition, being specified for the F1B meant that the system would be an air-to-air interception mode of attack. Thus the first function of both systems is to provide accurate radar



ASPANS components, laid out at left below nose of a Canberra jet bomber, include (left to right) head controller, attack radar, radar display, fire control computer and video

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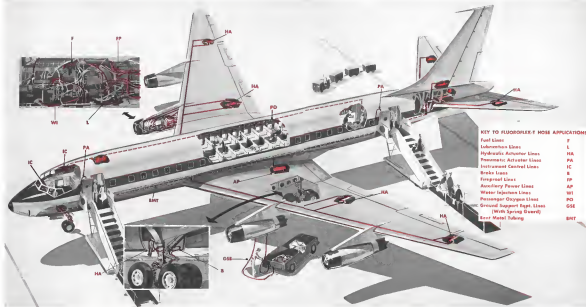
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## Why the airlines are turning to

Complete reliability is the reason. The plain fact is that more and more airlines, faced with problems of reliability, performance, and maintenance of plumbing systems, are retrofitting with Resistoflex hose assemblies of Fluoroflex-T.

In fuel, hydraulic, lubrication, water injection, oxygen and other special service lines, the increased maintenance and replacement demands of higher temperatures, rugged pressures, and corrosive solvents can be met most economically with

Resistoflex's Fluoroflex-T swaged-fitting hose assemblies.

Fluoroflex-T, Resistoflex's proprietary Teflon® product, is completely non-aging, completely unaffected by temperatures up to 450°F. The swaged fittings, pioneered and developed by Resistoflex, recently received WADC recommendation as standard for Air Force field assembly with tetrafluoroethylene hose.

What's more, Resistoflex's recently-developed portable swaging machine, which produces factory-quality assemblies in

## FLUOROFLEX-T

the field, further extends the maintenance economy of Resistoflex hose assemblies. More than 6 million Resistoflex swaged fittings have been used in Fluoroflex-T assemblies with never a blow-off in service.

So, for maximum performance, long life, and complete dependability—plus the resultant economies of minimum operational delays and maintenance—contract with Fluoroflex-T. Write for more information today.

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# ...NEWS IS HAPPENING AT HORTONF 1

This Radoplane machine does not detect the successful completion of its many surveillance missions. Involuntarily dubbed "Repeater" by its crew, this is not an unusual SD-1. Many Radoplane SD-1s do not have controls. Repeater's design, because Radoplane designs these systems to be rugged, simple, and reliable.



## ARMY'S SD-1 RACKS UP 31 MISSIONS ...READY FOR 31 MORE!

At the Army Electronic Proving Ground, Fort Monmouth, New Jersey, little SD-1 drones from Radoplane perform missions after mission. Involuntarily dubbed "Repeater" by its crew, this is not an unusual SD-1. Many Radoplane SD-1s do not have controls. Repeater's design, because Radoplane designs these systems to be rugged, simple, and reliable.

Reliability is the keynote in Radoplane design, whether the product is a tactical SD-1 drone like "Repeater," a target missile, or a landing system for a space vehicle.

PEOPLE'S AIRCRAFT  
FOR AERIAL SURVEILLANCE  
FOR TARGET TRAINING  
FOR WEAPON SYSTEM EVALUATION



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A DIVISION OF HORTONF CORPORATION  
P.O. Box 10, Orlando, and 11 West 34th

search and automatic target tracking. Second function common to both is to provide radar assistance for either blind or visual attacks using a variety of automatic weapons. The Lightning uses conventional, ruggedized rockets and the Harland Forward, infrared homing missiles.

The radar assistance has been contracted in August 11 to help the pilot attack surface targets. Because he would normally approach these targets at low level, the radar portion of August 11 can be used for ground mapping, for counter firing with existing air-to-air missiles as far as radar is concerned. In the latter case, the design gives the pilot steering signals so that he can follow a specific course and clear obstacles on route.

Original August system uses radar warning during the search phase and provides this information to the pilot. When he identifies a target, he locks the radar beam onto automatic tracking, and the approach computer in the system gives him signals to follow, to make the interception or the attack. This system is not completely automatic, but depends on the pilot to close the loop.

Light provides both a radar display and optical viewing at the pilot's choice. Radar hand controller is installed on the left side of the cockpit and used by the pilot to aim the scanning magnet in the direction he chooses. First photos of August system for the Lightning were shown in Arlington Hall, Sept. 13, 1958, p. 64.

## Israel Orders 26 Mirage 3 Fighters

France-Israel pact war may begin taking delivery of its first batch of French Dassault Mirage 3 interceptors.

The recent Franco-Israeli agreement marks the first export success of the French aircraft. Details of the contract have been kept secret and no official announcement will be made. The procedure, reported by Israel, was followed in past years when France sold Mirage jet fighters and Vector jet bombers to the Israeli air force.

French aircraft firms, however, indicated that the initial quantity ordered by Israel was 36 Mirage interceptors plus an option on an additional 14. Price of each aircraft was reported fixed at \$2,500,000. This price is slightly higher than the French quoted view trying to sell the Mirage 3 in West Germany.

France is also hoping to sell the Mirage to the Australian air force. An Australian mission currently is studying the aircraft in France. French air force has ordered 280 Mirage 3 with aerial refueling added to begin this September.

## HIGH POWER IN SMALL PACKAGES

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FORWARD propulsion of the Bertha Norman Cushioncraft is supplied by two Hiltex tail rotors, side entry port (right)



## Cushioncraft Designed for River Travel

By John Tinstall

London-Vancouver on the Pacific coast. The design was motivated by the desire to see whether a rudimentary, amphibious cushion craft, optimized for the purpose of transporting business men short range or river segments before shipment, could be made an economic proposition. Sports show 40 mph with no motor.

Backed by Eides and Eides, Ltd., British owners and shippers the new vehicle was designed and developed in part under tight scrutiny by two former U.S. Navy aircraft engineers, John Bertha and Desmond Norman of Ber-

tha Norman, Ltd., Buxton, England, for 10 years.

The design was motivated by the desire to see whether a rudimentary, amphibious cushion craft, optimized for the purpose of transporting business men short range or river segments before shipment, could be made an economic proposition. Sports show 40 mph with no motor.

Main advantages included:  
• Availability of cushioning surface due to buoyancy on road surfaces to do double duty as the first step.

• Cost of preparing a rudimentary cushion craft, less than one tenth per yard of an all-weather road.

• Independent during the design was not at all possible having only one or two cost.

• Exploitation of new plastics from one, successful because of high road costs.

On the other hand, the design was not at all possible having only one or two cost.



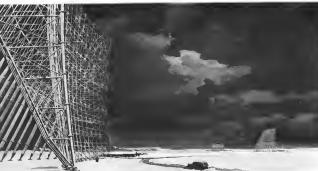
AMPHIBIOUS FAN has no hub and operates in three places by means of wheels, fan is driven by a sports car engine, transmission and rear wheel (left). Intake air passing over cushion through ring provides 10% of the lift. Vehicle is all wood structure.





## Somewhere North of Baffin Bay

The Arctic is almost as silent and lifeless as an Antarctic. But, deep inside it, there 400-foot long missile-launcher antennas will guard the life of our country.



They're part of a Bellaird Missile Early Warning System (MEWS). Officially, you'd call them surveillance radar antennas. Yet, they look like over-sized baseball bats. That web-like framework can detect (or spot) far-off missile darting through the shivering Arctic sky, and reflect its speed and direction to any of our military bases in seconds.

Up here, weather is a constant battle. Arctic storms stem into the 100-foot high antennas, and take icy fingers backward and forth over the mesh-laced structures. But they'll stand for years. The D. S. Kennedy Company, builders, made certain of that by welding foot after foot of USS National Seamless Mechanical Tubing into every antenna.

USS National Seamless Mechanical Tubing is an ideal load-carrying member, because it resists bending stresses in all directions and gives you a superior cross section. It shapes and loads alike. And for a given size and weight, this tubular form with-stands more load than other sections.

USS National Seamless Mechanical Tubing also fabricates into parts. It's stocked by National Tube Distributors all over the country. They will gladly show you how to use USS National Mechanical Tubing in your next application. See your National Tube Distributor.

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**CUSHIONCRAFT** is shoaled after it develops lift with its cushion. Four propulsion units are photo-controlled and is fully available.

two passengers and some outside cargo. Designed to operate at an altitude of 12-15 m., the vehicle is built of wood and uses a non-polluted sports car engine and transmission.

Total outfit so far amounts to about \$35,000, but similar version of this was could be sold for half this figure. Cost of larger vehicles up to 10 tons would work out. Nations estimates at about \$1 per lb. weight or about the cost per pound weight of light aircraft. Weight to horsepower ratio of propulsion vehicles would not exceed best automotive ratings.

### Annular Propeller

Low cost of the British Nations has- built propeller, largely from one of its members, is a result of the use of a simple method of generating the air cushion. Instead of using a centrally mounted ducted fan, the cushion is formed by a series of air ducts, each of which is a half of a full circle. The air ducts are arranged in a series of concentric circles, each of which is a half of a full circle. The air ducts are arranged in a series of concentric circles, each of which is a half of a full circle. The air ducts are arranged in a series of concentric circles, each of which is a half of a full circle.

Radio distance, however, are likely to put a fairly low practical use. Nations on the craft. In large craft the outer system can be duplicated, which would also enable the retention of more produced automotive units.

### Design Innovation

The British Nations has- built one of its members, is a result of the use of a simple method of generating the air cushion. Instead of using a centrally mounted ducted fan, the cushion is formed by a series of air ducts, each of which is a half of a full circle. The air ducts are arranged in a series of concentric circles, each of which is a half of a full circle. The air ducts are arranged in a series of concentric circles, each of which is a half of a full circle.

thrust discharging directly downward into the water.

Accordingly, Nations told At- a- time. When, the relative behavior of these two compression systems is roughly analogous to wing aspect ratio in the case of aircraft. By raising a large mass of air at a lower velocity than the buoyancy, it drives the same or greater advantage in its attitude with higher aspect ratio.

### Spray Effects

Because being more efficient the ground reaction is spray effects caused by the cushion are decreased considerably.

The actual jet velocity in the cushion is about 10 ft. per sec. about one third that of the jet velocity.

Loosening the annular ducts, the jet velocity is about 10 ft. per sec. about one third that of the jet velocity. The annular ducts are arranged in a series of concentric circles, each of which is a half of a full circle. The air ducts are arranged in a series of concentric circles, each of which is a half of a full circle. The air ducts are arranged in a series of concentric circles, each of which is a half of a full circle.

The proportion of lift provided by the cushion, which is directly related to the cushion pressure, is also reduced. When in the cushion the cushion develops virtually all the lift, as the British Nations craft is about one third of the weight. The cushion is developed about equally in the vertical component of the total jet thrust and the aerodynamic lift.



## First View of Enlarged Bell Iroquois Mockup

First view of new Bell UH-1D Iroquois helicopter, now under development, shown following mockup (normal rotor Model) recently inspected by a group of ten personnel attending a development engineering inspection at Bell Helicopter Corp.'s West Point, N.Y., plant (APRIL 27, p. 15). UH-1D has a larger rotor than previous UH-1 version, with capability for carrying 12 fully-equipped soldiers, a 50% increase in capacity.

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Until recently signal simulators for monitoring radar receivers or automatic radar sets of two types. One was a big and heavy engine enter with cumbersome auxiliary equipment; and the other was a nonlinear though definite instrument suitable only for the laboratory.

We call your attention now to the Litton 3800 series of miniature gas noise sources. The Litton 3800 for waveform use is pictured above. It has a fast start, the Litton 2007 designed for constant noise use. We call your attention because most tubes in this series are now in production and we expect there are frustrated design engineers who will receive this announcement with keen interest.

Our gas noise sources may properly be called miniature. They require only inches of space, smaller, lighter auxiliary equipment, and small voltages and currents. Around 500 volts from three 100 millihenry capacitors. These characteristics, plus others, have caused them to find numerous applications in the flight calibration and test of aircraft

navigation receivers; as automatic watchdogs on airborne radar systems; and in other systems which require various simulators in vibration, shock, humidity, and temperature cycling.

The Litton family of miniature gas noise sources like all Electron Tube Division products, was designed to offer specific end item functions. We have found that this philosophy translates to increased reliability, takes less time more efficiently, for longer periods of time, and is more reliable out to the limit. Other advantages also result. For example, these noise sources require no adjustment and the L-3800 is replaceable in the field without changing the mount.

Specific frequency ranges in L, S, C, X, and U bands are covered. If you are concerned with radar transmission, or with microwave data links of any kind, we'll gladly send you more information. Write to Litton Industries Electron Tube Division, Office A15, 901 Industrial Road, San Carlos, Calif.



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# CAPABILITY THAT CAN CHANGE YOUR PLANNING



## Commercial Hovercraft

London, A. 151m. Interest—the SRN2 is being constructed in the life of Weight by Hovercraft Development Ltd., and Westland Aircraft (Shoreham, Sussex, England). Design speed of the SRN2 is 70 kts, and the evolved hull will accommodate 60 persons (AW Sept. 24, 1969, p. 30).

SRN2 will be powered by four turbo-diesel engines, probably the Buehler-Motors during this life and several types possibly for future propulsion. The hovercraft is scheduled to be completed by the fall of 1971 which will make it the first entry in the commercial hovercraft field.

developed by the article as passing over the, usually shared ring of the rotor.

The swivel rotor which has no hub, is located in a circular track in which solid two wheels, on being rotated in each turn for a total of 180° which. Driven by a friction wheel the peripheral velocity of the rotor increases 140 mph with centrifugal acceleration of the rotor of 300g. The designers indicate that this method of locating a rotor under these conditions is one of the intricate details of the construction but feel that have already solved the problem. Here alone could such serious, reliable and this have solved this problem by using solid deflection rubber-band on polyurethane which has been recently developed.

The two-dimensional seals and generate a lift coefficient of 1.2 which forces is certain on each lift support. The rotor is also available to a relatively simple, variable pitch control if that is thought necessary. Rotation of the rotor is provided by slotted shafts, which prevent any longitudinal movement in the pitch axis.

Of the shell power high performance and maximum capacity of a system produced. Concrete Cylinders sport an engine and a Rotax MG engine. The gas has which together cost less than \$400. The substitution device a standard strong or wheel with a Mulsius X two which is loaded vertically and directly as the upper surface of the rotor thinned. During the development program the largest (largest) automatic engine, using the Guel in each landing wheel as the friction drive wheel, will be used. The Guel from vehicle, power engine is covered and the same high developed engine are engine in Britain and can be covered continuously at 170 mph and 4,700 rpm.

A power shaft drives from thicker full rotor which are driven clockwise for propulsion and differentially for maneuvering purposes.

Pioneering is our business...

## BENDIX 2" FLIGHT INSTRUMENTS

All integrally lighted to MIL-L-85467A



### SENSITIVE ALTIMETER

BENDIX TYPE 141—Sensitively accurate 5 pointer altimeter indicating in feet. Operating from several inches pressure sensor. Operational pressure-altitude range—8000 to 100,000 ft. Adjustable, ground level pressure referenced. Meets MIL-L-85467A, Class B, 1 of 10 of the MIL-Altitude (WGL-100), certified for helicopter use.

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BENDIX TYPE 172—Provides indication of vertical rate of ascent or descent up to 8000 ft/min. Temperature and altitude compensated. Compensation also provided to reduce errors due to rapid rate of change in temperature of static source. Adjuster also provided for zeroing. Meets MIL-L-85467A, Class B.

### AIR SPEED INDICATOR

BENDIX TYPE 140—50 mile/hour (ground) scale. Shock-free mounted, through temperature compensated display ring. Change by difference between static pressure and the air through which the plane is flying to find the impact pressure indicated by the static pressure indicator. Meets MIL-L-85467A.

### TURN AND SLIP INDICATOR

BENDIX TYPE 173—Provides attitude independent 0 to 180° turn and 0 to 180° slip indication. Built-in scale indicates 180° turn and 0 to 180° slip. Change by difference between static pressure and the air through which the plane is flying to find the impact pressure indicated by the static pressure indicator. Meets MIL-L-85467A.

### Easy to read, accurate, dependable

Each of the above instruments is panel mounted and has a two-color illumination dual. They are integrally lighted to meet with MIL-L-85467A and by night.

white by day—by 8 volts AC or DC. Operating temperature range is -55°C to 175°F. Day also is provided with white light.

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Avro 748 turboprop testbed is shown on its maiden flight from A. V. Roe, Ltd.'s, flight test field at Woodhead, England.

## Avro 748 Turbine Transport Makes First Flight

Prototype of Avro 748 turboprop testbed has made its first flight 17 months after A. V. Roe, Ltd., made decision to proceed with the project. Plane will be about 5476,800 (AW Sept. 24, 1914, p. 74) and is powered by two Rolls-Royce Dart Mk. 514 turboprops of 1740-shp each. First flight level 7 to 45 m. Plane's gross weight is 15,000 lb. Project included construction of a mockup and a second mockup, used for structural testing in a water tank at Woodhead, England (AW Nov. 30, p. 62).



Transport carries 40 passengers at 250 kt. cruise speed. The T4E utilizes Vickers Viscount system and power pack.



## Rotary-Wing Booster Recovery Studied

New York—Controlled recovery of high-thrust rocket boosters and nose cones by means of rotary wing systems will be investigated for the Air Force by Kansas Aeronautics.

The rotary wing simulation device, also applicable to the recovery of ejecta and space capsules, will be studied by Kansas under a Fiscal 1968 Air Research and Development Command contract totaling \$595,800 (AW Jan. 4, p. 70). The rotary wing recovery method is thought superior to bailing wire glider and parachute methods in that it permits a dynamically-controlled descent and a low impact landing with a maximum weight penalty. However, studies of other retrieval methods are under investigation.

Kansas's AARDC contract will consist of two phases, which will be conducted concurrently. The first phase will concern the building and testing of a 196 lb rotary wing device. This device will be released from altitude at high subsonic speed (500 ft/sec) at altitudes to 50,000 ft. This will provide investigation of high subsonic deployment, retention, guided control of descent to a preselected landing site and flare-out landings with zero net velocity in both horizontal and vertical directions.

The second phase of the contract calls for a study to determine the feasibility of recovering large payloads at hypersonic speeds from high altitudes.

The helicopter concept considers the rotary recovery system a natural extension of two earlier programs, the Rotachute air delivery package and the cruise helicopter guidance project. The Rotachute, developed for the Navy and Marine Corps, delivered payloads from 6 to 900 lb with both fixed length and telescoping blades from 1 to 24 ft in diameter. The Rotachute, although successful in tests, was never placed in production.

The company's cruise helicopter—a Kansas RTK-1, demonstrated, controlled hovering and cruising flight in 1952. The project was conducted under Office of Naval Research contract.

### Subsonic Tests

The subsonic rotary wing recovery tests will employ a modified KRC-1 Rotachute. The 196 lb package (blades folded back) will be mounted on the bow of a jet aircraft and released at a speed of 500 ft/sec. Upon release, a delayed action squib actuates a tension spring and retracts a cone to force all four blades to pivot and extend out from the body axis. Simultaneously, another squib actuates the governor compression spring causing the blades to sweep forward and impart initial ro-



Rotachute, high speed air delivery vehicle, will demonstrate effectiveness of controlled recovery by means of rotary wing installation device.

tation to the rotors. Once the rotors are brought up to speed, the system is free-oscillate directional stability will be provided by a fold-out tail fin.

Rotor speed is governed by a large compression spring, sitting through a lever which retracts or extends the rear portion of the blade flapping levers. This creates a constant speed rotor by changing the collective pitch of the blades. A windup, blade pitch lever and connecting links provide cyclic pitch.

### Initial Tests

During initial tests a ground source controlling temple of a cable hanging from the rear of the Rotachute will initiate flare-out sequence.

The flare sequence begins by moving the mainplane (the electrical pilotage) to the full lift cyclic position and leaving the governor spring to increase rotor rpm. After a preset time interval, the longitudinal cyclic returns to neutral and the governor spring is compressed to cause the blades to go to increase collective pitch. This should reduce vertical speed of the Rotachute sufficiently to achieve a maximum speed ground impact.

The control system consists of a die roller screw system in the lateral axis only. Longitudinal axis control is held at a constant angle to po-

tion a predetermined glide slope during controlled flight. "Levflight" control signals are interpreted into command signals to introduce lateral cyclic control to the blades. The data link is a two-way, pulse amplitude modulation-TSI system.

### Test Drops

Approximately 15 drops will be made with the Rotachute during recovery investigations. The first five drops, to test the opening, descending and landing sequences, and the following 10, to test cyclic control, will be made at speeds no greater than 250 ft/sec and altitudes to 5,000 ft. This will permit testing at Kansas's Goodfield, Conn. facility. The last 10 drops, utilizing full guidance and controls, will be made at higher altitudes at speeds to 500 ft/sec and will require a military test range with radar facilities.

Phase two of the rotary wing recovery study will attempt to define the optimum conditions and optimum applications for the concept.

This feasibility study will include:

- Studies to determine optimum and hypersonic atmospheric characteristics of various blade sections, main body configurations.
- Performance performance surveys to determine the relationship between rotor

and vehicle configurations. Optimum number of blades, vehicle velocity versus rotor rpm, vehicle air versus velocity and trajectories and aerodynamics, mechanical and structural requirements will be investigated.

• **Dynamic analysis** will be performed to determine generator requirements for a selected range of periods and rotor velocities.

• **Aerodynamic heating effects** at hypersonic speeds will be studied to determine blade structural requirements, possibility of blade cooling and system requirements for hypersonic operation.

• **Opening cycle characteristics** of selected periods and configurations will be studied in effort to reduce peak accelerations.

• **Generator requirements** for transition from hypersonic to subsonic flight conditions will be studied.

• **Several selected vehicle parameters** will be investigated to show height and velocity of deployment, estimated gross weight and components weight of the vehicle, rate of descent obtainable,

requirements for testing and the necessity for special metallurgical techniques. Stability improvement, generator characteristics and flame-out techniques also will be included in the report.

## Japan Commands Air Defense Centers

United States forces in Japan are scheduled to turn over three air defense control centers to Japan's self defense air forces this month. The centers are located on three U.S. bases—Fukushima, Misawa and Iwakuni—which were granted to U.S. forces under the U.S.-Japan mutual security pact just around the time which has been the center of a political crisis. Last year the U.S. turned over 16 radar stations to the Japanese and the air defense control centers are the next step in the process of making the Japanese to take over their own air defense. The centers have been partly manned by Japanese and U.S. personnel for some time.



**Missile Component Uses Chemical Milling**

Technique called Chemi-Bec, developed by Aermet, Inc., Los Angeles, Calif., can bring low quality steel and other metals previously thought unfit for aircraft and missile use to the forefront at a specific price. Above is stainless steel dome (4015 AMS steel) for a missile fuel tank which was brought to a tolerance of .04 in. through chemical milling which cleaned surface pits.



**MOTOROLA Military Electronics Division**

## EVOLUTION & REVOLUTION

**REVOLUTION** in electronics may have its genesis in the evolution and synthesis of four prime areas: the rapidly maturing technologies of semiconductor development and production, surface passivation and stabilization research, electronic ceramic engineering and controlled thin film deposition. Synthesis of effort in many scientific and engineering disciplines is required to achieve breakthroughs in these areas and accelerate the evolution from conventional to microelectronic circuitry. The Solid State Electronics Department of Motorola's Military Electronics Division is exploring this approach as the key to long life and reliable performance of electronic equipment by eliminating excessive complexity in component interconnection.

**RELIABILITY** improvement demands a reduction in the number of point-to-point connections used in equipment design. Highly specialized engineers, physicists and chemists, at Motorola, are making significant contributions to the new art of non-topological integrated circuitry. All well-qualified scientists and technicians seeking professional growth will find stimulation and challenge in the Motorola Solid State Laboratories.

**RECOGNITION** and reward will be won by those who, by disciplined research in integrated circuits, help secure unconditional reliability. Write to the office in the area of your choice.



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There's good reason why most of today's commercial and military jets rely on Bendix brakes. Products of the world's most experienced brake manufacturer, they are specially designed and

built to meet the extra-heavy ground control demands of these high-performance aircraft. In fact, "Bendixes by Bendix" signifies safe, sure ground control—whatever the aircraft.

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## Lockheed Develops New Escape Capsule

Lockheed Aircraft Corp. has developed an aircraft escape capsule under study contracts for USAF's Wright Air Development Division which is calculated to combat recent communications effects up to 100,000 ft altitude. The capsule, proposed for airplanes in the 1961-63 era, will be built principally at Inglewood.

Lockheed's concept is to make the escape capsule into a separate capsule that could be parachuted safely into any nation, including water, would be able to float adequately, and would contain an emergency radio and survival means such as paratrooper and life boat. An oxygen supply would be provided. For escape at up to altitudes of 100,000 ft, the following items would serve astronauts when the ejection button was pushed:

- Three wedge-shaped stabilizers extended from the capsule section.
- A separation rocket, burning for 1 sec., would thrust the entire section upward and forward at the altitude.
- A parachute would deploy for float duration at about 15,000 ft., slow the high drag stabilizers slow the capsule. The wedge-like fin are designed to enable the capsule to have aerodynamic stability during its free fall.

High speed separation could be accomplished on or near the ground as well as at high altitudes, over the cap-

able gives sufficient altitude boost from the rocket catapult before the para chute opens to lower the capsule to earth.

The basic escape system was designed around the F-104 for maximum functional mission, according to Lockheed.

## British Army Confirms Order for 36 DH Beavers

British Army Air Corps order for 36 Canadian de Havilland Beaver aircraft has been made formal. Most cargo planes will be manufactured by Canadian de Havilland, shipped to England and assembled at de Havilland's Chester factory.

First deliveries are slated for late 1960 and the contract should be completed during 1961.

## Australia Evaluating U.S. Foreign Aircraft

Secrets Australian team is conducting a five-country investigation of new equipment for possible adoption into Australia's new defense forces with view to U.S. aircraft manufacturers. The team began a 16-day evaluation of the F-104 fighter at Lockheed's California Division last month.

In addition to testing English, French and U.S. aircraft manufacturing firms, the Australians discussed their requirements with West German and Swiss officials.



## Liquid Oxygen Tank Built for Atlas Complex

Over seven feet 25,000-psi liquid oxygen storage tank from test yard to not cut at Ford and Scott Corp. plant in Los Angeles, Calif. Vessel will be installed at Fairchild AF, Wash., liquid oxygen-producing facility which will serve the operational Atlas missile launching complex now under construction.



## New Tatnall Metal Film 102 higher-temperature backed strain gages from **Bulfinch**



- Operating range to over 500°F.
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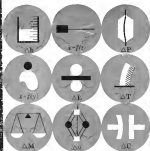
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probe to any simply constructed capacitance sensor that suits your special needs. Everything else you need is built right in... including an easily read meter that may be bypassed if necessary to facilitate external recording, display, or control.

You'll have no trouble finding jobs for your Delta Unit. The device is so basic that it hardly has any limitations. Complete details are on Data Sheet 904-L, available on request. The Decker Corporation, Sole Company, Pennsylvania.

THE DECKER CORPORATION Sole Company, Pennsylvania

## WHAT'S NEW

### Reports Available

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

**High Energy Rate Metal Forming—Report No. 5-615 A. F. With and G. N. Randa, Lockheed Corp. for Air Materiel Command, USAF. Apr 1-June 30, 1959. \$4.00, 267 pp. (PB 161274)**

**Heat Treatment of High-Strength Steels for Airframe Applications—by R. J. Fiorino, D. R. Roach and A. M. Hall, Defense Metals Information Center, Defense Metals Institute, for Department of Defense. November, 1959. \$2.50, 131 pp. (PB 151070)**

**A Review of the Air Force Materials Research and Development Program—by H. Maxwell, Materials Laboratory, Wright Air Development Division, USAF. November, 1959. \$3.00, 168 pp. (PB 151640)**

**Research Program on High Vacuum Precision Final Repeat-Letter Indicators of CalM for Air Research and Development Command, USAF. March, 1959. \$3.00, 168 pp. (PB 161111)**

**Standards for Connected Cable Products Proposed—Available without charge from the Committee Standards Division, U. S. Department of Commerce (While supply lasts.) (SP-6512)**

**Subject Index to Unclassified ASTIA Documents—Army Services Technical Information Agency. \$10.00—9 volumes, 2,647 pp. (PB 151187)**

**Ames Research Technical Information Agency—Office of Technical Services. Conclusion Index of Technical Reports \$3.00 (PB 151575)**

**Determining Air Resistance as Moving Vehicles—Part 3: Methods of Hydrodynamics—by M. Z. Kornevich, University of Chicago, for Wright Air Development Division, U. S. Air Force. July, 1959. \$3.50, 217 pp. (PB 161141)**

**High Speed, Electrochemical Gauge—by Wayne George Corp., Wright Air Development Division, USAF. May, 1959. \$7.75, 28 pp. (PB 151926)**

**Fundamental Investigation of Electronic Power Sources—Vol. II—by E. J. Holland, Ph.D., Hammond Corp. for U. S. Air Force. April, 1959. \$2.25, 57 pp. (PB 161362)**

Not a worry in the world ...

WITH THESE TOOLS!  
SNAP-IN CONTACTS  
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Deutsch-designed for your peace of mind—these special tools, for crimping (manual or automatic), inserting and removing the contacts in Deutsch DS miniature connectors, are simple to use, foolproof, fast and reliable—even in the hands of unskilled operators. The Deutsch eight-sided crimp is stronger than AN #18 wire itself.

WHAT'S MORE...our patented mechanism locks the contacts in place so they withstand at least 25-pounds pull...making Deutsch DS miniature connectors completely reliable.

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- 7 shell sizes, with alternate crimping and insert arrangements
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So why worry? For details on a completely reliable snap-in type connectors, contact your local Deutsch representative or write for Data File 15-7.



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good mind  
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Result? Repeated successful firings of Allison designed and produced light-weight Minuteman cases—definitive proof of the validity of Allison's design philosophy, the soundness of Allison's processing.

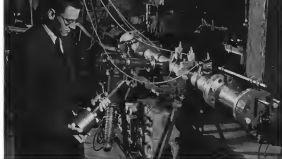
And this is but one of the many space-age projects we're putting our minds to at Allison—minds backed by every General Motors resource.

Whether your problem is concerned with the heavens, the earth, or the oceans, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others—we could do it for you.

*Illustrated is a section of a minuteman jet case showing a special thread developed by Allison for the aft closure of the full-scale Minuteman rocket motor case.*

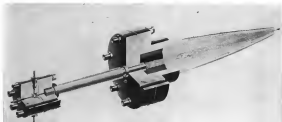




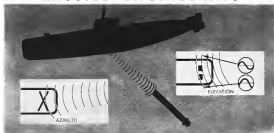


## Hypervelocity Gun Propels Projectile At 18,000 fps. for Wake Studies

Hypervelocity generator developed by Aero-Everett (Miss.) Research Laboratory for Army accelerates projectiles to over 18,000 fps. for studies of wake phenomena as applied to subsonic and space vehicle reentry projects. Generator transmits actual velocity, whereas conventional shock tubes simulate true velocity. Spherical nylon projectile 0.22 in. in dia. is accelerated by hydrogen pressurized to 125,000 psi. in a driver chamber 7 in. long and 1 in. in dia. Maximum hydrogen temperature is 15,000K. Before firing, the driver section is separated from the 30-in. long barrel by a diaphragm which ruptures from the force of a 20,000-v. capacitor discharge. Gases from hypervelocity generator are large enough to heat the driver gas by compression. Dark outline in x-ray photo at right is a shock wave that, in original photo, measured 5 ft. in length. Within the shock wave are two particles which appear as two bright spots. In top photo, generator's barrel is held by Steven Cropper, Aero scientist. Window through which x-ray photos are made is at the end of generator.



## MISSILE ENGINEERING



OPERATION of Mk. 44 transducer group permits two-course correction in azimuth and elevation to intercept target. If some errors arise, one set of transducers more directly than the other, direction will be changed until amplitude in the same. A phase angle difference is produced when the signal slides over set of transducers before the other, indicating a depth error.

## Navy Orders Homing Torpedo Production

Washington—Navy has ordered the General Electric developed Mk. 44 active homing torpedo into production after a two-year evaluation, and the weapon will be used by the fleet against high performance nuclear submarines.

Mk. 44 torpedo is the non-reloadable pyro-fused for the Anson submarine missile system (AW June 27, p. 32). It can also be dropped from attack, surface and fired from existing surface shipboard torpedo tubes. Mk. 44 has been under development by GE since 1954.

Mk. 44 is 108 in. long and one foot

in diameter. Original thermal drive was scrapped in favor of electric propulsion when GE's electric developed the high power Mk. 61 air water battery. Electric power was found to be superior to steam as reliability, power-to-weight ratio and handling ease with the new battery. Silver chloride and magnesium lattice plates are dissolved until vented by sea water. Storage lifetime is said to be unlimited, with no requirement for recharging.

Active acoustic homing located in the nose section is a sensitive low-frequency sensor with sound-to-electric

transducer groups. When a target ping is returned, transducers exhibit anti-math and direction error, take the torpedo out of its coning search and aim it on a direct path to the submarine.

Because Mk. 44 operates at high speed, design of shell, propeller, fin and ahead rings were hydrodynamically integrated to prevent cavitation from jamming the acoustic homing.

Aluminum shell is lightweight aluminum. The metal is more resistant to salt air than magnesium, which also was tested. With aluminum, Mk.



SILVER CHLORIDE and magnesium plates are used in the Mk. 61 air water battery (at left) to power the Mk. 44 torpedo electric drive. Batteries do not require recharging during long storage life. GE says that it has a higher power-to-weight ratio than other marine batteries. The Mk. 44 torpedo (right) is 108 in. long and one foot in diameter. Finer and pusher fins in the nose section. Window at the center, and the ahead control batteries and gear box. Skin in forward section are for use during in-sonar applications. Airframe and launch clamp are in the aft body when the torpedo is rocket-launched.

# FIERY BIRTH OF A SUPERSONIC SPEED BRAKE... AT 2000° F.



## AERONCA designs, tools, produces and tests advanced brazed honeycomb structures

In the production of exotic high-temperature air weapon components, there is no substitute for actual experience. That is why Aeronca... with production records on several thousand brazed stainless steel honeycomb sandwich assemblies... is one of the recognized leaders in this highly specialized field.

And to meet the growing requirement for complex high-temperature structures, Aeronca has evolved a fully integrated facility for design, tooling, producing and testing all types of brazed honeycomb sandwiches. This special facility includes more than 65,000 square feet of plant area and the most advanced production and inspection equipment available today. Brazed structures up to 14' x 24' can be produced on volume at present.

Whether your requirements, Aeronca's experience and capabilities can ensure you of uniform quality, on-schedule deliveries and the lowest overall cost consistent with reliability and performance specifications. Our customers will verify that Aeronca produces results... not claims!



This composite speed brake for a new air weapon system illustrates Aeronca's advanced capabilities. Photo at top shows side of same unit emerging from furnace after brazing cycle (indicated temp. 2000°F).



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46 has without external structural shock, of high speed water entry in air deep and Area tests.

Mk. 44 torpedoes will be produced at the Navy's Forest Park, Ga., ordnance plant, which produces all fleet torpedoes. Current production includes three models of the Mk. 43, the Mk. 37 and the Mk. 15 Mod. 3, as well as the Mk. 44. Mk. 15 is a stream drive, is carried only on ships and has no booster. Both the Mk. 43 and Mk. 44 can be launched by aircraft as well as ships. The 20 in. diameter Mk. 37 is launched only from ships and operated by its nuclear payload.

## PRODUCTION BRIEFING

Raytheon Co.'s Missile Systems Division will continue production of the Army Hawk surface-to-air missile under a \$56 million contract. Hawk production will be performed at the division's facilities at Andover, Lowell and Woburn, Mass., Oxnard, Calif. and Bristol, Tenn.

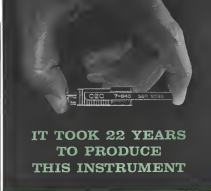
Westinghouse Corp., East Springfield, Mass., will build launching equipment for the Martin Bullpup anti-aircraft missile under Navy contract. The contract involves approximately 2,400 hours.

Chromalloy Aerospace Division, Dallas, Tex., will develop and test electrochromium-coated panels under a \$108,000 Bureau of Naval Weapons contract. The electrochromium-coated panels employ a phosphorescent material sandwiched between two electrical conductors. The material glows when a electrical power is applied. The panels will be flight-tested in Chromalloy F3U aircraft.

The Singer Corp.'s Harford Division will produce ground support equipment for the Convair Tornado missile under a \$128,000 Navy contract. Production of the components will be accomplished at the division's El Segundo, Calif., facility.

Port & Watson Aircraft Division of United Aircraft will develop new applications for its turbine engines in a new, forward-fuselage Bombardier aircraft. The development effort will attempt to tap industrial markets for the use of gas turbine ground power units.

General Electric's Missile Production Section, Burlington, Vt., will continue production of the Vulcan 23 mm. aircraft cannon under a \$1,947,000 contract. The aircraft cannon series in armament on the Lockheed F-104, the Republic F-105 and the Convair B-35 and B-36.



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### You're looking at one of CEC's new high-performance galvanometers

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But its performance is what makes this instrument unusual. CEC galvanometers offer the ultimate in high-performance characteristics. They're available in 14 types with a wide range of frequency response.

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## Reporter on the prowl Norden's Doppler Wind-Distance Computer

In anti-submarine warfare operations, the Navy's Air Arm acts as an aerial eye transmitting target information to surface attack vessels. Norden's compact, lightweight Doppler wind-distance computer presents the pilots with a continuous display of wind velocity and provides accurate information on distance travelled. In the absence of Doppler return, the wind-distance computer continues to provide distance data, based on air speed and computed wind information.

The Norden Doppler wind-distance computer project, successfully developed for the Naval Air Development Center at Johnsville, Pennsylvania, testifies to the company's capability in the airborne sensing computer field. And every Norden achievement in the area of advanced electronics is another step toward extending man's capabilities.

Stimulating gazillions are available at all levels of responsibility for qualified engineers and scientists.



**NORDEN DIVISION  
UNITED AIRCRAFT CORPORATION**

STAMFORD, CONNECTICUT



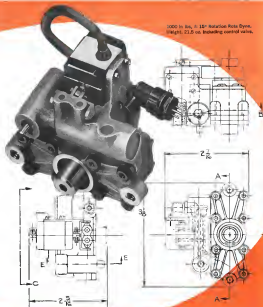
Titan ICBM is now emerging from underground launcher at Vandenberg AFB, Calif. Steel and concrete domes protect site from attack.

## Titan Underground Launcher Prototype Undergoes Tests

Prototype of an operational underground launcher for the Titan intercontinental ballistic missile is undergoing tests at Vandenberg AFB, Calif., in preparation for first launch from this facility. American Machine & Foundry Co. will build 36 such systems under an \$81,007,000 contract (AW July 4, p. 15) and will install them at Ellsworth AFB, S. D.; Minotaur Home AFB, Minn.; Los Angeles AFB, Calif.; and Beale AFB, Calif. Manufacturing will be at General Electric, and Bufile, N. Y.



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The Rota-Dyne is a true rotary servo which can modulate angular load position over ranges less than a full revolution. It employs a unique sealing technique which is quite simple, but virtually leak-proof and highly reliable. Developed in a company-sponsored program, Rota-Dyne offers these advantages and design features:

- Direct drive of fins, rudders or other loads
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- Integral gas filter
- Low weight to torque ratio
- Mechanical position feedback
- Frequency response within 3 db to 10 cps
- Inlet gas temperatures to 2000°F
- Tapco supplied liquid or solid gas generators
- Low production costs

If you would like further information on Rota-Dyne servos, write on your company letterhead. Tapco Group sales engineers are available for consultation at your convenience.



10,000 lb. Rota-Dyne, 120° Rotation Rota-Dyne



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In all ways, Rene 41 is a remarkable alloy. No other high-temperature alloy used in production today equals its tensile strength. In other properties, too, Rene 41 is far ahead of the field.

Also important, this nickel-base, vacuum-cast alloy is easy to work with. It's readily formable by drawing, bending, spinning — yields to similar or dissimilar materials.

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full down to .001 in thickness... and fine wire only .0015 in diameter.

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## FINANCIAL

### Financial Briefs

Western Air Lines, Inc., one of the few airlines in the U.S. to even a profit in the first quarter of 1960, has declared a regular quarterly dividend of \$8.75 a share, payable Aug. 5. Previous cash dividends were paid on Mar. 4 and May 15, and a 5% stock dividend was distributed on Mar. 23. A Western spokesman said that passenger revenue to Boeing 707 jet service introduced to major Pacific Coast markets in June 1 has been excellent.

Norway Corp. reported net income of \$5,157,900 for the first three quarters of Fiscal 1960, equal to \$2.90 per share on 1,800,000 shares outstanding, and based on six-month sales amounting to \$170,166,908. The company's backlog increased by over \$60,000,000 in the third quarter to a total of \$181,000,000. Expenses resulted primarily from new contracts related to the Polaris missile system and increased expenses in the guidance system for USAP's Skybolt missile.

Lockheed will reduce its \$17 million deferred development costs for its jetStar military transport by applying a percentage amount to the purchase cost of five airplanes ordered off-the-shelf by USAP (AW June 27, p. 15). Lockheed declined the development costs rather than charge them against recent but year on the assumption a military order would be forthcoming.

### Mergers And Acquisitions

Details of the merger between Aerowest, Ltd., and Heston-Chen, Air Transport, Ltd., under the name British United Airways, have been announced (AW May 7, p. 134). The proposed merger of Aerowest will hold a 60% interest. Heston-Chen owns the remainder. Group chairman will be M. D. N. Webb, chairman of Aerowest, and deputy chairman will be Sir Nicholas Gwynne, chairman of the British and Commonwealth Shipping Co., which has a 50% holding in Heston-Chen. Consolidated fleet of BU will total 52 four-engine aircraft and 54 helicopters, believed to be the world's largest helicopter fleet.

General Milk, Inc., of Muskegon, Mich., acquired the business of The Sherm Co., Livingston, N. J., and Lubbe Manufacturing Co., Muskegon, N. H. Davis supplies high quality



## TRAFFIC COP FOR "GO" FUELS

Since they fed the first bird 22 years ago, Grove pressure regulators have set the pace. It is fact that original Grove designs are still the basis for every pressure regulator used in ground support systems today. Specify Grove regulators for dependable pressure control.



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AVIATION WEEK and Space Technology long ago recognized the unmistakable fact that—men responsible for the aerospace industry's progress must be informed of scientific and technical developments virtually as they happen.

This basic premise led to the pioneering of a new type of technical reporting that has rendered other methods practically obsolete in the aerospace industry.

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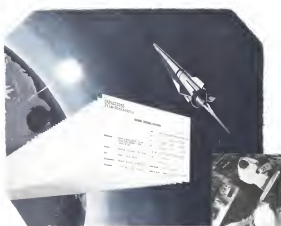
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## SORTE...

### summary of radiation-tolerant electronics

Fast neutrons and other nuclear radiation effects the life and performance of electronic systems. Problems of both safe effects and integrated design are emphasized in the design of advanced military and space systems.

At Bendix Systems Division, we have compiled a comprehensive file which we call SORTe for Summary of Radiation-Tolerant Electronics. Under Air Force agencies ship, we have exposed electronic components and components to nuclear radiation, tested them for radiation damage, and compared performance with control tests made before exposure. Similar tests have been run for improved components selected by manufacturers. Tests from

tests and reference sources are arranged on cards to make up the SORTe file. Over 1400 electronic components are already listed.

Based on our test programs and SORTe, Bendix engineers are developing a new approach and methodology to the design of radiation-resistant systems. This approach optimizes the trade-offs between workload environments, component resources, shielding, size and weight.

To assist us in this work, and programs such as satellite communications systems, advanced radars, systems, and the EAGLE air-to-air missile system, we invite inquiries from engineers looking to the future.



Bendix engineers use the Summary of Radiation-Tolerant Electronics (SORTe) file to select components.



Bendix engineers select data for radiation-tolerant components from SORTe file.

**Bendix Systems Division**  
AN AIRCRAFT CORPORATION



## Aerjet Builds Dual Thrust, Solid Propellant Tartar Motor

Dual thrust, solid propellant motor for Nike-Corvus Tartar shipboard anti-aircraft missile (AW Aug. 17, 1969, p. 32), shown at top left, is in production at Aerjet-General's Sacramento, Calif., plant under a \$2.5 million contract. Two stage booster and sustainer have been compressed into single unit with one ignition system; after center section booster burns out, the lower thrust booster sustainer (center section) takes over. Workman (below left) has completed motor units using which will be shipped to the Solid Rocket Test Plant to be fired with payload. At right, a completed Tartar is shown on its launcher at Naval Ordnance Test Station. The weapon has been ordered by Dept. of Defense (AW Aug. 15, p. 33).

components to the electronic modules. Reliable manufacturers provide well-sorted resistors and other subassemblies for The Davis Co.

Quarrel Machine Works, Inc., Niles, Ill., purchased the Hydraulic Press Division of Bethlehem Engineering Works, Inc., Joint, Ill. Bethlehem products line acquired includes presses for laminating plywood, wood-plastic board products, metal, plastic and rubber.

Negotiations are under way between Avco, Inc., and Electrical, Inc., for acquisition of Electrical Avco is located in Woodside, N. Y., and Electrical is in Kingston, N. Y. Avco, a leading producer of electronic instrumentation systems, recently acquired Calson Laboratories, East Orange, N. J., and Tindall Corp., Boston, Mass. Electrical

manufacturers produce hydraulic components and systems and is the largest producer of complete landing gear systems for the multi-engine aircraft.

Amper Corp. and Tektronix Magnetics are considering a merger, based on an exchange of 10% shares of Tektronix Magnetics for one share of Amper stock. Amper would be the surviving company. Negotiations are still in progress, and if completed will then be submitted for approval to the boards of directors and stockholders of both companies.

Consolidated Aircraft Co. has completed arrangements for purchase of a 49% interest in the French aircraft firm of Avione Mrs. Heiler, Reims, holder of the 25 passenger Super Bessard turboprop (AW Feb. 15, p. 33). Three of

General's top executives—Douglas L. Wallace, president, F. A. Biedtger vice president and treasurer, and D. L. Koshlan, vice president of aircraft division—have been elected directors of the firm.

Keweenaw Chemical Co., Berwyn, Pa., manufacturer of both compounds in petroleum, coal-tar and bitumen has purchased a 10% interest in Penn. Rure Merck, Inc., Revere, Pa.

Cara and Co., Los Angeles, Calif., electronics sales engineering firm, has acquired Moss, Inc., New York City, an electronics manufacturer's engineering firm.

Director of Buys Controls, Inc., and The Wright Line, Inc., have voted to merge subject to stockholder approval. New company will be called the Barry







High alloy  
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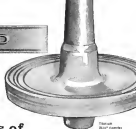
**To  
speed**

## **the progress of gas turbine development**

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Titanium  
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high temperature alloy  
12 1/2" diameter  
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High alloy steel  
12 1/2" diameter  
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# **WYMAN - GORDON**

**FORGINGS**

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WORCESTER, MASSACHUSETTS

DETROIT, MICHIGAN

GRAFTON, MASSACHUSETTS

LOS ANGELES, CALIFORNIA

FULLERTON, CALIFORNIA

PORT WASHINGTON, TEXAS

Wright Corp. and R. P. Collins, now president of Wright, will become chairman of the Board. Elmer Pratt, now president of Barn Controls, becomes president and chief executive officer. Barn Controls manufactures shock and vibration equipment for aircraft and missiles and Wright makes antennas and precision card handling equipment for data processing and computer systems.

Little Corp., industrial communications and electro-mechanical research company, has acquired Allied Research & Engineering Division of Allied North Mfg. Co., Hollywood, Calif., active in missile components field. Nicholas Smalley, Jr., will manage the new Little division.

Division of Permanent Filter Corp., Los Angeles, and Thermoform Corp., of North Hollywood, Calif., have agreed to an offer by Permanent Filter to acquire Thermoform, subject to approval by California Corporation Commission. Both firms are active in the missile field.

Joint ownership of S. G. Brown Ltd., Woking, England, has been acquired by American Rocket Arms Corp. and de Havilland Holdings Ltd., a member company of the Hawker Siddeley Group. S. G. Brown Ltd., a producer of precision navigation and gyroscopic equipment.

Seismic Associates, Lexington, Ky., has been acquired by Vazair Associates, Palo Alto, Calif., through a stock exchange. Dr. Otto G. Krupp, president of Seismic, was elected chairman of the board at direction of the stock's new subsidiary. Vazair acquired all outstanding capital stock of Seismic and then issued 12,500 shares in the company, with additional shares issued as investments, to a maximum of 50,000 shares, but only if Seismic attains profits required by the acquisition agreement.

Ruthen Corp., Redwood City, manufacturer of chemical and electronic insulation for missiles, aircraft and computers, has purchased Bendley-Russell Mfg. Co., Conshohocken, Pa., for 50,000 shares of Ruthen stock. Little firm produces drawings and tubing for electrical insulation.

Director of Northeast Metals Industries, Inc., Philadelphia, Pa., have approved a merger agreement with Vanguard Air & Marine Corp., holder of the Vanguard 3C line of jet airplane (AW Oct. 19, 1958, p. 120). Deal is subject to stockholder approval and was previously approved by Vanguard's



**Braking Fins Stop Sled at 2,688 mph.**

Extended braking fins safely halted nuclear missile sled designed by Northrop's Space Division. Hawthorne, Calif., runs a 2,688 mph test run at Holloman AFB, N. M. Fins are fixed into sled's pointed nose as well as on flat surface kept from sliding until the instant of sled's burst. Then the radial deployment causes fins to open about two inches after which they are turned out to full braking capacity by the wind blast. The 16-ft. dual rail sled, tested will be used to test inertial guidance system components at the Air Force Missile Development Center.



AVIATION WEEK, July 11, 1960

143



### Static Test Firing of Minuteman Second Stage

Successful static test firing of Minuteman second stage motor engine takes place at Aerojet General Corp.'s Solid Rocket Plant, Azusa, Calif. Second stage engine action observed solid propellant. Aerojet is prime mover for the second stage propellant system and is conducting research and development work on the propellant system for the Minuteman third stage. A second test firing test made use of altimeter engine for a large motor. Directed higher than static between one without firing so will that the same engine will be included for another test.

director, Edward G. Vanderlip, Van guard personnel, will head the new firm. Alfred H. Boulder, president of Northrup Aircraft, Inc., is chairman of the board. Major expansion will return the Vanguard name.

**DWCO Instrument Co.,** Brooklyn, N. Y., builder of gas level, counter, timer and servo systems, has acquired the Matco Division of Eastman, Inc., which makes rotary and digital clocks.

All the stock of Applied Radiation Corp. (ARCO), Walnut Creek, Calif., has been acquired by High Voltage Engineering Corp. Stock was obtained on the basis of one share of High Voltage Engineering for every 100 shares of ARCO. The latter firm will continue to operate as a separate corporation under its present management.

**Tetron Electronics, Inc.,** has acquired Alpha Instrument Co., Cranford, N.J., in exchange for 140,000 shares of Tetron Electronics common stock. Alpha manufactures electronic and pressure measuring devices used in testing of rockets and missiles.

### New Offerings

**Control Data Corp.,** Minneapolis, Minn., engaged in the design, development, manufacture and sale of computers, equipment and components used in electronic data processing and auto-

matic control for military, scientific and industrial uses. The company is currently raising \$1,000,000 of stock to finance the balance for working capital and other corporate purposes.

**Electronic Specialty Co.,** Los Angeles, Calif., engaged in designing, developing, manufacturing and selling electrical and electronic instruments and components as well as electronic systems and solutions for military, industrial and scientific institutions. Offered in 198,000 shares of common stock for public sale, offering price and underwriting terms to be supplied by memorandum. Proceeds will be added to the general funds of the company in anticipation of its medium and long-term capital requirements, which may include the purchase of other businesses if favorable opportunities arise.

**Colco Corp.,** San Diego, Calif., engaged in the design, development and production of electronic devices and systems, primarily for the precision tracking of missiles, satellites and aircraft. A substantial portion of the company's business is research and development. Offering in 90,000 shares of common stock, 25,000 shares to be offered for the account of the company and 65,000 shares for the representative accounts of Walter I. Zoble (president) and Robert W. Wines (vice president). Offering price will be related to the current market price of the outstanding stock at the time of offering, underwriting terms to be supplied by memorandum. Thousands of the sale of 25,000 shares in the company will be used to provide additional working capital for anticipated further increases in sales volume. The company expects to use \$400,000 to build up

radio control for military, scientific and industrial uses, various instruments and control devices primarily for use in missile and military research, and electronic equipment primarily for power and gas analysis and pipe line companies. Offering in 121,000 shares of common stock, the public sale, offering price and underwriting terms to be supplied by memorandum. Proceeds will be used to



### Quail Category II Tests Near Completion

Category II tests are nearing completion at the McDonnell GAM-72 Quail drive aircraft, which is scheduled to fly to the test site at Edwards Air Force Base, Calif., and will be used to provide and conduct tests on the Quail. The aircraft is a single-engine aircraft, which is a modification of the B-72, producing a high speed and high altitude tests resembling that produced by the B-72.

in excess of \$400,000 to finance construction, and \$100,000 to acquire additional electronic test and manufacturing equipment.

**American Electronics, Inc.,** Los Angeles, Calif., engaged in the manufacture and sale of certain ground support equipment for use in the aircraft and missile industry; the manufacture and sale of certain electronic-electronic components for use in various electronic systems related to the aircraft and missile industry; the manufacture and sale of software and computer software and accounting systems for use in toll roads and in parking lots and groups specialized environmental testing systems; the manufacture and sale of nuclear testing equipment. Offering in 100,000 shares of common stock for public sale, offering price will be related to the current market price of the outstanding stock at the time of offering, underwriting terms to be supplied by memorandum. Of the proceeds, \$100,000 will be used to acquire leasehold improvements for the plant and facilities being research and development at Palmdale, Calif.; the remainder will be added to working capital, including the replacement of \$1,000,000 of short term bank loans and the payment of \$1,000,000 of current accounts payable.

**Kaestlin Corp.,** Solana Beach, Calif., a research and development production, an electronic engineering firm, is seeking to raise \$1,000,000 in common stock. The company is engaged in the design, development and manufacture of electronic systems for the aircraft and missile industry. Offering in 100,000 shares of common stock at \$10 per share. The first public stock offering is to be completed under its registration in February 1977. The entire issue was subscribed within five days.

**Servotronics, Inc.,** Alexandria, Va., an electronics design and manufacturing company, offered subscription rights for 70,000 shares to shareholders of record on May 25 (June 1977, June 15), on the basis of one share per \$10 held at a price of \$7 per share. Of the 70,000 shares, 30,000 shares were received on 74,000 shares, shareholders requesting subscription rights held for a total of 75,000 shares. Of the proceeds it is anticipated that approximately \$75,000 will be used for the purchase of additional equipment and facilities for company expansion; approximately \$25,000 to provide additional working capital to finance contracts already proposed to the company; \$100,000 to provide a bank loan due in June 1982 up to \$75,000 to finance current operations on property being sought for construction of a facility in the northern Virginia area.



### JETS GET THEIR FLIGHT PLAN DATA PROCESSED BY COMPUTER HOUSED IN



### EMCOR CABINETS

An EMCOR cabinet houses an electronic computer designed to furnish flight plan data for DC-8 Jetliners, United Air Lines, Chicago, Illinois. The computer stores in its memory the operating and performance characteristics of the DC-8 aircraft, including such things as fuel flow, air speed, rate of climb, cruise, climb rate, engine head-rings, distance between check points, etc.

EMCOR design "know-how" in producing standard cabinets featuring the most modern concept in metal industry in keeping pace with the advances in air travel. The flexibility, versatility and structural capabilities of over 600 basic frames in the EMCOR MODULAR ENCLOSURE SYSTEM bring advanced engineering and "engineering" in metal electronic and instrument enclosures.

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## BUSINESS FLYING



AERO COMMANDER 500A shows streamlined, swept-back wing which reduces the aircraft's forward cross-section by 40%, while saving about 10%, and increasing takeoff and single-engine performance. Engines are Continental IO-470-Bs, with fuel injection.

*Aviation Week Pilot Report:*

## Aero Design's 500A Shows Power Gain

By Robert L. Stafield

Reading, Pa.-based performance of the new Aero Commander 500A reflects the extensive design and configuration changes including the installation of fuel injection engines—that Aero Design & Engineering Co. (Bethany, Okla.) has worked into its line of corporate aircraft.

The 500A, the first and lowest-priced of the new Commander line, will pose few problems for the executive pilot who may fly less frequently than the professional. Cruise speed of 250 mph, plus, fuel consumption of less than 7 gal/hr at 51% power, marked climb stability and good engine-out characteristics were evidenced during evaluations by Aviation Week.

Six to seven phase light twin is powered by two Continental IO-470-B fuel injection engines, each generating 268 hp at 2,625 rpm. Propellers are two-bladed Hartzels at 80 in. maximum and

maximum diameter. Cruise speed, 20% power, 13,000 ft., is specified as 220 mph. Range, 45% power with 10 min. fuel reserve, is 1,800 mi. Service ceiling is 21,500 ft. Empty weight is 4,075 lb.; maximum gross is 6,000 lb.

### Design Features

New Commander represents the biggest changes in configuration since the company introduced its presidential Model 720 in 1977. The low-wing, flat, swept-back cowling marks a 40% reduction in aircraft's forward cross-section, reducing drag some 10% and increasing takeoff and single-engine performance (AW Aug. 31, p. 217). Revised main gear retraction system turns the gear 90 deg. so that they lie flat and within the contours of the nacelle air ducts. Rapid gear extension and retraction time is about 5.5 sec.

Airfoil characteristics of the cowling have reduced stall speeds some 5 to 8 mph. Nacelles, which themselves provide lift,

add to main cabin effective wing surface. Airplane's 180-in. main gear moved from 12-12.1 to 12-12.1. Cowling 9 in. less deep than on previous models, add to increased side visibility. Fuselage and engine nacelle, for cooling, have been replaced by exhaust ports which dump exhaust at the optimum negative pressure area on top of each wing, and aid in reducing cabin noise.

Engines are cooled by two electrically operated "flaps" atop each nacelle, though aircraft usually are flown (including the conventional) with cowling closed. There should be few maintenance problems with the new Continental company, to avoid excessive cooling, also has closed off 80% of one side of the air intake for each engine, which also aids in drag reduction.

Though performance gross weight of the 500A is 6,000 lb., the airplane can be loaded up to the maximum structure gross weight of 5,000 lb., adding to its

adaptability for expert work—transportation.

Basic cost of the 500A is \$72,000. The first of about 15 models produced by early June was delivered to Big Brother Aircraft Co., Atlanta, Ga. The first of the Model 500B series was rolled out in mid-June and will be priced at \$81,700. The new Model 500F will be available in early July, at a base cost of \$111,500. By late July the Model 500F will be available at a cost of \$99,500.

President Commander, the 720A, will be available later this year. Aero Design already has sold five years' production (over 100 aircraft) and output has been stepped up from 12 aircraft monthly in January to 15 in March. Commanders are built in order, and the plant maintains an inventory of finished aircraft. Building currently numbers 32 airplanes, with delivery dates now about five months from time of order. Aero Design employees have increased from 745 in January to 915 at present.

### 500A Demonstrates

Decompressor Commander 500A used in the Aviation Week evaluation was N7503R, the second aircraft to come off the Aero Design production line. It's a smart looking airplane, the biggest noticeable change being in the sleek, flat look of the engines. The powerplants are rated 415 in. over previous model lines, increasing horsepower up 20% with the fueling.

Cowlings are hinged on the lower side, quick release latches exposing most of the engine. At the end of the rowing can be laid back and lowered to the ground. Engines are mounted on single-point aluminum brackets. Five fuel tanks down in a central tank. There is no cross-engine fueling in the fuel system, there is but one fuel pipe and one filter. Total capacity is 184 gal.

Battery compartment and external power supply hook-up are located in the aft left end of the fuselage. Two 12-v. batteries are hooked in series. Luggage space is located just aft of the baggage door, left side, with a volume of 37 cu ft. and a maximum capacity of 310 lb. Radio racks are easily accessible through the rear of the baggage compartment.

Cabin interior is made up of up-bolstered metal strips, which are easily unbolstered and replaced. Demonstration contained three seats, in addition to the dual cockpit seating, plus a bunk for a sixth seat. For passenger comfort and convenience doors are oriented windows adjacent to all seats, a ceiling coat rack, built mounted seats, and overhead vents and reading lights recessed into valence panels (lamps mounted at the rear of the cabin track are "baiter and baiter" and "no smoking" signs, activated from the



500A cruises at 250 mph, has service ceiling of 21,500 ft., range of 1,800 mi.



REVISED main gear retraction system on the 500A turns wheel 90 deg. so that they lie flat and within the contours of the nacelle underside. Gear retracts in 5.5 sec.



ENGINE instruments are mounted in the center panel of the 500A, along with the gear handle, directly above control quadrant. Main panel can take dual flight instrumentation.



ARCO COMMANDER production line at company's Bethany, Okla., plant has increased production from 12 to 16 aircraft per month.

graduated safety-light switch. Cockpit seating in the 500A is comfortable and visibility from ground level is good. Engine instruments are mounted in the center panel, along with gear handle, direction-throw control quadrant. Flight instruments in this airplane are varied in the left main panel, cockpit's side was busy, but could take duplicate flight instruments.

Light gray panel provided good contrast to instrument lighting.

#### Standard Equipment

All equipment in this airplane is standard, with the exception of the complete Dac media package, including

160 channel transistor two 500 channel radios, glide slope, five-light marker, ADF etc. Package includes weather-erasing all radios on one panel. All electrical and starting switches are located overhead, in one row, along with elevator and rudder trim.

Turning on of master switch automatically activates an electric hydraulic pump that provides pressure for brakes and flap, engine will bring pressure up to 576 lb. at air flow in falls below 100 ft. Continental engine of the 500A fired up easily, and with some pressure for braking in necessary, airplane was smoothly maneuvered from the ramp out to run-up position.

Field elevation at Reading Municipal Airport (Glo Sparty Field) is 545 ft. Sea level pressure at altitudes was 29.94 in. Wind was calm. Outside air temperature was 72°. With three of us aboard, including Charles Morgan, director of sales training for Aero Design, and Ben Wallace, service manager, the 500A ground out at about 5,010 ft.

#### Takoff and Climb

Before takeoff 10 deg. of flap was lowered to give airplane a "flatter" attitude. This also adds to back seat passenger comfort. With full power applied, the Commander moved quickly down the runway. We went to high boost on the roll, at full power, to avoid landing. Aircraft also leaned out on takeoff (to 50 ft./sec.) for the same reason, exact opposite turn about 15 ft./sec. engine rpm reduction to 2,300 rpm on climb-out.

Normal climb of the 500A was made at 65 mph, and, as recently became so,

before after a run of about 1,680 ft. "flatter" attitude was held as speed quickly built up to 140 mph, best fuel initial climb and single-engine performance. Minimum single-engine control speed is 70 mph.

With gear down flap retracted, the Commander was held to 100 ft. per sec. of climb.

None level was moderate, and suitable for good.

At 500 ft., climbing, the port engine was pulled back to zero thrust. Direct-

tion was maintained with about 12 deg. advance (no saddle) and aircraft attitude was held constant as airspeed dropped to stalling at 105 mph. Climbing through 1,000 ft. in that configuration, engine speed was at 500 rpm. At 1,500 ft., still climbing, both engines indicated 500 mph, rate of climb was 400 ft./min. During this single-engine climb the port flap retracted closed, both engines holding to temperature normal.

Bringing back the power on the "dead" engine, airplane passed through 4,000 ft. indicating 125 mph and climbing 1,180 ft./min. Stability at this 500A was good. Hands off flight could be set up during straight-ahead ascent and during climbing turn reentering 70 deg. at bank. The airplane accelerated itself through 6,500 ft., power in 75 in. standard pressure and 2,500 rpm, indicating 125 mph and climbing 100 ft./min.

#### Cruise Settings

At 2,000 ft. the 500A was leveled off for runs of varied engine settings with these results (outside air temperature, 82°):

• 65% power. Fueling 23 in. and 2,490 rpm, gear flat about 7 hr. of 21mp. plus time to alternate, the Commander indicated 170 mph for true reading of 146 mph. Fuel flow was 66 lb./hr., about 11 gal./hr. for each engine.

• 45% power. With engine back to 20 in. and 2,100 rpm, the airplane indicated 145 mph for a true airspeed of 170 mph. Fuel flow was 49 lb./hr. each engine, or less than 11 gal./hr. total. Vibration was slow approximately 12 in. cadence.

• 31% power. Reduction to 14 in. manifold pressure and 2,000 rpm resulted in indicated airspeed of 129 mph, normal holding and approach speed. Total fuel consumption was 40 lb./hr. or less than 7 gal./hr. Stability at this speed was apparent in the 500A, with boost of 1 in. to 15 in. manifold pressure. Flow fluctuated at 15 deg. bank, indicated speed dropping to 115 mph. And to the pilot during long holding periods was obvious.

#### Slow-Flight Stability

During this hands-off, slow-flight demonstration without touching the rudder gear and one-quarter flap (10%+) was lowered. The airplane stabilized quickly at 170 mph indicated, descending at the rate of 500 ft./min. Control held steady. With gear and flaps raised—executed a manual approach—the 500A went "cross field" at 150 mph, with the main fuel flow (and evidencing good fuel management).

Manual approach climb-out was initiated by boosting power to 23 in. manifold pressure, leaving the same trim,

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CD-3	100	460	4
CD-4	120	560	4
CD-5	140	660	4
CD-6	160	760	4
CD-7	180	860	4
CD-8	200	960	4
CD-9	220	1060	4
CD-10	240	1160	4
CD-11	260	1260	4
CD-12	280	1360	4
CD-13	300	1460	4
CD-14	320	1560	4
CD-15	340	1660	4
CD-16	360	1760	4
CD-17	380	1860	4
CD-18	400	1960	4
CD-19	420	2060	4
CD-20	440	2160	4
CD-21	460	2260	4

\*Weights include 100 lbs. for oil and 100 lbs. for fuel.



Model CD-1 Model CD-2 Model CD-3 Model CD-4

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high and accelerated at 500 fpm. The stability of the 800A gave a fine job for the pilot.

The Commander 800A has a good mix entry and a moderate rate of descent, with engines in zero thrust and airplane held to level attitude. This was demonstrated by Morgan, who reduced power to 10 in. and 2,500 rpm at 7,200 ft. Nine min was needed to get the wings level and under pedal; the airplane lost about 750 to 800 fpm during descent. Speed held to 58 mph, indicated. The Commander was moved off the task by backing smoothly power to 10 in.

### Still Speed

The airplane was stalled in leading edge-down (nose and full flaps extended), power to zero thrust (10 in manifold pressure), at 6,800 ft. Still turning was indicated about 7-10 mph before the back, with aileron control alone holding the Commander level. Still speed approximated 50 mph indicated. Another time pilot had a tendency to hold the nose high, with a resultant dropping of the right wing, but second attitude was held during ascending attempts with aileron adjustments applied.

Single-engine, with 55% power applied to starboard propeller (22 in. and 2,700 rpm), buffet occurred at 65 mph indicated. Again, with aileron control alone, the attitude was held and recovery was quick. With power again advanced, and climb sustained at 30 mph indicated, rate 730 fpm, each flap still remained closed, cylinder head temperatures holding to 180C—in the green.

### Rough Air

Again at zero thrust the airplane had no tendency to stall up during descent. With gear and flaps extended, winged nose indicated 130 mph, the 800A moved through 7,000 ft. at 400 fpm. At 4,500 ft. power was advanced to 25.5 in. and 2,450 rpm for a run through some turbulence as Rough air characteristics over the Pennsylvania hills were good. With outside air temperature 110C, the 800A indicated 210 mph and 20 mph below V. Airplane in yellow band at 250 mph and red band at 280 mph. The speed makes a control problem difficult, in one aspect.

Maximum speed for gear extension is 180 mph for full flaps, 150 mph for half flaps, 135 mph. Positive gear load factor is 3.4g. There is nothing central about the pattern speeds, which usually run from 120 mph (low for instrument work) to a final approach at 100 mph, the airplane normally being brought out the fence at 90 mph and let down at 75-70 mph.

It was found that during gear is not approach and landing which is

## PROBLEMATICAL RECREATIONS 22



A certain number is the product of three prime factors, the sum of whose squares is 233. There are 7560 numbers (including unity) which are less than the number and prime to it. The sum of its divisors (including unity and the number itself) is 10,560. What is the number?

—Solomon L. Madansky

Integrated Data Processing, Inc., which converts coded numerical information from punched paper tape into finished financial statements, has been acquired by Marvin Calculating Machine Co., Inc., one of our dealers.

ANSWER TO LAST WEEK'S PROBLEM: The hour and minute hand coincide 11 times in 12 "hours." Your watch gains 5/11 minutes every 65, or 1 hour every 143.

**LITTON INDUSTRIES**  
Beverly Hills, California



Environmental testing of T-1000, a 1000 Watt, 1000 Watt Radar System, developed and produced for the Texas Instruments Agency.

**TI IN HEAVY RADAR SYSTEMS**

**TEXAS INSTRUMENTS**  
INCORPORATED  
3001 LAMAR AVENUE • DALLAS 5, TEXAS

## BENDIX ANNOUNCES NEW AND EXTENSIVE WEST COAST FACILITY



## FOR CABLING USED ON GROUND BASED ELECTRONIC EQUIPMENT

Scientilla Division of Bendix has scheduled for September completion this new 30,000-square-foot plant at 1006 S. Grand Ave., Santa Ana, Calif. It will offer West Coast users the finest, most complete facilities in the area devoted exclusively to development and manufacturing of cabling used on ground based electronic equipment.

West Coast mobile industry producers, particularly, will benefit by having this new facility "on their doorstep," bringing them the latest and best in cabling for missiles and supporting ground equipment.

Bids and service for all Scientilla Division products—including cables and connectors—will continue to be handled out of 117 E. Providence Ave., Burbank, Calif.

**Scientilla Division**  
BENTIX, NEW YORK



### Emeraude Awarded Airworthiness Certificate

Emeraude CP301A, manufactured by Paul Amis, Le Dorcy, France, has been awarded an airworthiness certificate shortly after its second test flight. The aircraft was being flown under restricted certification. The Emeraude CP301A, a late development of the CP300 which first flew in 1952, is powered by a 96 hp Continental C550F14 engine. The two-seater cruises at 220 mph, has an empty weight of 135 lb., gross of 1,400 lb. and a range of 600 mi. with 10-gal. fuel reserve.

substituted a minimum of roll. On one landing approach we tried both a deliberate high approach and one in which we tried to use a long base leg. In the former, the airplane rose to 1,400 ft. above the runway, on final, until we lost the approach and under the nose. Underneath this would mean a go-around, but with one of the most described earlier we could get in to the 1,151 ft. strip with plenty of room to spare.

Before running through the area direct approach from base leg a short field takeoff was made with the 500A trimmed 5 deg nose up and full flaps extended. The airplane, with no wind, was off the ground at a high angle after a run of but 900 ft. Covering ground for the full landing, power on both on gear was reduced to 17 in. manifold pressure and 2,250 rpm. on base leg, where 10 deg. of flaps were dropped. With wing held to 150 mph indicated, the airplane held to a 900 rpm rate of descent. Full flaps were extended on final, again down to 160 rpm. At no time was an increase in power necessary.

### Operating Costs

Hourly operating cost of the Emeraude 301A is estimated at \$15.74. Breakdown of Aero Design hourly figures follows:

- Inspection: Normal 100-hr. inspection \$2.75, normal 50-hr. inspection, \$2.
- Overhaul and maintenance: Rolls overhaul and maintenance, 604; instrument overhaul and maintenance, 524; propeller overhaul each 900 hr., 224,

unmaneuvered engines each 900 hr., \$1.91.

• Fuel and oil: Fuel, on the basis of 25.6 gal./hr. at 24 in. per gal., \$9.55. Oil consumption one pint per hour, and change at 50 hr., 70¢.



TI Transmitter in Space Exploration, built by TI Transmitter, Inc., Santa Ana, Calif.

## TI TRANSMITTERS IN SPACE EXPLORATION



## PRIVATE LINES

Glendale Amateur's Super-V light twin is a variation of the Beech Bonanza to twin engine configuration (AWN Oct. 76, 1964, p. 168). It has been certified by Federal Aviation Agency E. H. Cough. Glendale Amateur president, and a national sales program will start immediately, under direction of Ken Bellman, sales manager. Super-V participants are two Levening 180 hp engines installed in low drag nacelles.

Field Airlines Co., Ltd., Toronto, Canada, is spending about \$1 million in aircraft change, sales and overhaul facilities at Midland Airport. Completion date is August, according to Victor Kohn, general manager. Field Airlines also has facilities at Oshawa, Calgary and Ottawa.

Air Associates, Inc., Teterboro, N. J., has formed an international division for aircraft sales. Division is managed by Adolph Finkel.

Air Tux Co., of Newark, N. J., will offer charter and air taxi service out of Greenwood Lake Airport, West Milford, N. J. James Lusk, Air Tux president, and company also will operate a flight school.











### S-62 Lands at Off-Shore Mine Site

Sikorsky S-63 delivers helicopter lands at the Gulf of Mexico. The helicopter made the 150 mi. round trip in one day.

the top wing surface and the survivors stated that they could see the structure in the center of the wing.

Weather was not a factor in this case. But although a five-minute delay in the rescue could have resulted in the victims' deaths, with village reported at about 4,000 ft. A number of ground rescuers saw the aircraft after it had crashed into the water and in the desert. The probable flight path of the S-63, depicted in the chart, is based on evaluation of the sightings of these rescuers.

Several witnesses located west of the boat were described looking at the aircraft on a nearby landing in a river the clouds. They reported hearing an unusual sound similar to that of an aircraft landing the sound heard. Shortly after hearing the sound they saw three objects fall out of the aircraft. These objects were located and proved to be engines Nos. 1, 2 and 4. The sound of a jet engine continued and the aircraft was seen to emerge from the base of the clouds on a northerly heading. It rose to an altitude of about 100 ft. and then descended. Other witnesses located northwest of the boat saw the hearing aircraft still descending, make a sweeping left turn, passing over the sail of the *Laurel* and then disappear out of a northerly heading of about 130 deg. They said that during this time they heard an explosive noise and the jet engine could then be heard after this noise which could be heard after this noise a boat whirling away. Several of these witnesses who were familiar with the *Laurel* T-12 stated that there was only one engine on the aircraft and that it struck the *Laurel* during the turn when the boat was in the water where the boat had been. One witness said that the boat had been using a large portion of the trailing edge of the wing in the area of the No. 2 engine.

The search continued on its southeast

only landing down River Creek and there made a point right turn to a heading of 130 deg. For this time it had descended about 100 ft. The search continued to the heading of 210 deg. Its short one turn, during which it descended until it reached the ground. Four hundred feet from this first point, the aircraft crashed another one or two times along the north bank of the river, at a height of about 50 ft. The aircraft then descended to the ground where it crashed from 7 to 13 ft. It was approximately the width of the wing span and showed that the aircraft was in a wing-level attitude. A section of the left wing tip, 16 ft. long, was located by one of the witnesses. The left wing, which was damaged, was found at a point 10 ft. from the crash site. The left wing, which was damaged, was found at a point 10 ft. from the crash site. The left wing, which was damaged, was found at a point 10 ft. from the crash site.

### First Contact

The first contact with wreckage 110 ft. high was on the north side of the river and about 1,000 ft. from the point at which the wreckage struck the ground. Four hundred feet from this first point, the aircraft crashed another one or two times along the north bank of the river, at a height of about 50 ft. The aircraft then descended to the ground where it crashed from 7 to 13 ft. It was approximately the width of the wing span and showed that the aircraft was in a wing-level attitude. A section of the left wing tip, 16 ft. long, was located by one of the witnesses. The left wing, which was damaged, was found at a point 10 ft. from the crash site. The left wing, which was damaged, was found at a point 10 ft. from the crash site.

The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground. The aircraft crashed on the ground.

altitude and ground impact it was in contact and was not subjected to the ground force which consumed most of the other wreckage.

The section of the left wing tip, located by contact with the river on the north side of the river, came to rest about the river approximately 10 ft. below the first of the wreckage which was damaged by the remaining wing structure. The wing, from the point at which the tip was found and extended to the landing gear lower end strap, was broken up and scattered over a distance of about 10 ft. The wing, from the point at which the tip was found and extended to the landing gear lower end strap, was broken up and scattered over a distance of about 10 ft.

### Fire Damage

There was extensive fire damage to the left side of the wing of the No. 2 engine on the outer left side of the aircraft, and to the left side of the engine.

The wing upper skin from the center of the left side of the wing was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged.

From the area just left of the wing leading edge, the left side of the wing was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged.

The center wing skin on the No. 3 engine was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged.

The left side of the wreckage was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged. The skin was found to be damaged.

## TIROS GROUND STATIONS...



### Nerve Centers For A Satellite

Over 75,000 information cloud cover pictures have been received from TIROS-1 since it was launched on April 1. In two months the satellite had completed 3,000 orbits and traveled 77,000,000 miles. This means not only that TIROS-1 has performed as planned, but that the complex problems of ground and control as well as signal reception and processing have been successfully overcome. Like the satellite, the ground ground station equipment were designed and built by RCA Astro-Electronics Division under the guidance of NASA and technical direction of the U.S. Army Signal Corps.

Major components at each of the four ground stations include:

- Two TV cameras and fast frame receivers used in direct connection to television signal lines.
- A processor which pre-processes different combinations of operating modes, and a 256 word command accumulator.
- A TV camera to display the picture signal for the automatic recording centers. The camera is equipped to make either positive or negative film.
- An indicator and an image converter which presents an index number and map scale indication for each picture, and for geographical orientation.
- An attitude pointer which picks up the earth-to-sun signal for sun axis position computations.

- Two standard 4-channel tape recorders to back up the monitor.
- Two paper recorders to store for forty film-based satellite pictures.
- An antenna preamplifier which directs the antenna to follow the path of the satellite when it is in range of the ground station.

All ground stations are served by a master clock which is coupled to standard time signals from WWV. In addition to normal picture data transmission and receipt functions, the preprocessor can also command spin up. After two months the spin rate had increased to 8.8 rpm, due to the effect of the earth's magnetic field. On command from the ground, two solid propellant spin-up rockets on the station were fired, increasing the spin to 12.8 rpm.

TIROS-1 was ground station was used to process photos from the mission tapes for the first one hundred orbits. The integrated design and development of these TIROS ground stations is an indication of RCA's capability in total satellite systems. This capability will become increasingly critical as more and more complex satellites and more pictures are used to improve earth's understanding and control of all activities. To discover how you can draw on the talent & experience, contact the Marketing Manager, RCA Astro-Electronics Division, Princeton, N. J.



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RCA CORPORATION OF AMERICA





## WHICH JOB WOULD YOU TAKE?

If you're like most of us, you'd take the job with the more tempting salary and the brighter future.

Many college teachers are faced with this kind of decision year after year. In fact, many of them are virtually bombarded with tempting offers from business and industry. And each year many of them, dejected but discouraged, leave the campuses for jobs that pay fair, competitive salaries.

Can you blame them?

These men are not opportunists. Most of them would do anything in their power to continue to teach. But with families to feed and clothes and educate, they just can't make a go of it. They are virtually

forced into better paying fields.

In the face of this growing teacher shortage, college applications are expected to double within ten years.

At the rate we are going, we will soon have a very real crisis on our hands.

We must reverse this disastrous trend. You can help. Support the college of your choice today. Help it to expand its facilities and to pay teachers the salaries they deserve. Our whole future as a nation may depend on it.

It's important for you to know more about what the expanding college crisis means to you. Write for a free booklet on **HIGHER EDUCATION**, Box 56, Times Square Station, New York 36, N.Y.

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also supported by his fact that the airport had almost stopped receiving air support.

When the accident hit the town on the north bank of the river and a 10 ft. section of the left wing was severed, the control traffic was unwilling to maintain the wing level. As it moved the wing the aircraft rolled rapidly to the left to a bank angle of approximately 35 deg. and crashed on the creek bank.

### Conclusions

The Board concludes that the accident was the result of the structural failure of the No. 1, 2 and 4 nacelle pylons and the loss of the nose wheel tire. No. 2 nacelle broke off. It also concludes the accident had as a result of probable as proved on them during several weeks of unaided gymnastics which were reconstructed when the pilot became applied emergency manual movement as an attempt to correct from a Dutch roll.

The Board further concludes that the instructor pilot orbited the Dutch roll to an angle of bank far in excess of the limitations imposed by the company. In addition, the instructor pilot was fully aware of these limitations and was, in fact, reminded of them during the flight. Even so he persisted the pilot position, who was on his first training flight to strange maneuvers from their extreme maneuvers.

It concludes that after analysis of the accident had been regarded, Mr. Braun had selected an incorrect clear area for the emergency crash landing but failed to make it be possible to make the No. 1 engine had to be shut down prematurely to help the wing level.

Subsequent to the accident the company should do training activities to reduce the possibility of recurrence of a similar accident. The limitations on angle of bank for the Dutch roll maneuvers have been explained to all company pilot personnel. In addition, Dutch roll limitations have been defined so that the pilot-in-command will have more experience in the initial phase to interrupting the maneuver.

The company has also incorporated a full time limited soldier status in the aircraft. In addition, it has increased the vertical resolution test and has added a revised 10. These changes are anticipated to substantially increase the low speed control characteristics of the aircraft.

### Probable Cause

The Board determines that the probable cause of this accident was the structural failure induced during an emergency recovery, through loss of a Dutch roll, which occurred the angle-of-bank limit prescribed by the company.

By the Civil Aeronautics Board  
WILLIAM CHAMBERS  
Chairman  
GEOFF CHERRY  
Vice Chairman  
C. JAMES MANN  
Member  
ALAN S. BIRD  
Member

The Civil Aeronautics Board was created by the act of Congress on July 19, 1959. As an independent agency immediately established in accordance with the provisions of Title

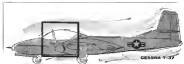
48 of the Federal Aviation Act of 1958, it is located at the Federal Aviation Administration, Washington, D.C. 20581.

Mr. Ronald H. Braun, age 32, was employed by Boeing Airplane Co. June 7, 1957, as a Test Pilot "B". He was promoted May 2, 1958, to Experimental Test Pilot "B". He held no FAA airline transport pilot certificate with a rating in the B-707. His total flying time was 5,081 hr. at which 509 was in the B-707. His latest FAA check, a physical was taken June 2, 1959. Mr. Braun had received a total of 10 hr. of ground school instruction on the B-707, plus a cockpit and systems familiarization class on the B-707. According to testimony of a Boeing Airplane

Co. employee, Mr. Braun was fully qualified to act as instructor pilot on the B-707.

Capt. John A. Burke, age 40, was employed by Boeing Airplane Co. April 13, 1958, and promoted to captain in April 1959, and to check pilot in 1, 1959. He had a valid FAA airline transport pilot certificate with ratings in the DC-1, DC-4, DC-6, DC-7 and 1,000 hours. Capt. Burke had a total of 29,841 flying hours. His latest FAA check physical examination was taken Apr. 1, 1959. Capt. Burke had completed the Boeing Airplane Co. pilot training ground school course which consisted of 160 hr. of instruction. This was his first training flight in preparation for check pilot on the B-707.

Capt. M. Frank Bales, Jr., age 41, is a



## TRAINING CHALLENGE: MET BY CESSNA

**The challenge:** To keep pace, in student-pilot training, with the vast progress in technological advancement. Answer: Cessna's high-performance, highly modernized T-37. Pushing side-by-side seating, enabling the instructor to observe the student's every move—this most advanced primary trainer in Air Force history helps students learn more, faster, more safely than ever before.

Side-by-side seating is one of many features the Air Force finds the T-37 most time saving of this wings design. Proportionately, Cessna's is now at work to assure America's future in the air.

Activity  
Division,  
Wichita,  
Kansas





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Please write to Mr. J. G. Peck, Box 596 HB, Professional Employment Office, 14513 Georgia Avenue, Chagrin Falls, Ohio 44024.

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Supplies Received \_\_\_\_\_ Trees Received \_\_\_\_\_





## LETTERS

### Work Well Done

For the past five years, two men, David Mudge and Ray Hunt, have been doing an outstanding job as the turbine engineering section of BCU at the Atlantic Mobile Range, Patrick AFB. These men have the responsibility to inspect all modifications to the A-6E Force range aircraft so they can be safe for training flights.

The searchers have included helicopters, lighters and bomber-type planes, however, the power modification has been to the C-54 and C-119s used. These planes are completely remodeled into JC-119s and JC-15s. Many modifications are made to enhance air-to-air defense, the number of work that go into the making of JC-54 and JC-119 aircraft.

As an example of what I mean, is the cover picture used on the June 15 issue of *Newsweek*. That is a JC 54, not a C 54 as supposed. The dome modification for the equipment shown in the photograph had to be designed, built and test flown in only a few days. The design, in fact, was the making of two new skins that allowed for the top half to be opened in flight, and special fittings to hold the test equipment.

It is true, if they didn't do the work someone else would, but they are doing it and should be congratulated on work well done. (None withheld his praise.)

## Talent, Ltd.

I am sending you some documents which by far, I hope have not grown too stale. In the light of the U.S. focus on our candidate's associations at the State Department and of Central Intelligence is crucial. The adoption of well proven business procedures to this end is indicated.

To irritate the State Department, as the owner of spangled intent loudly a said on the British Foreign Office immediately suggest that Personnel office should therefore be set up in one of the better London hotels and advertising placed in the London Times, *Manchester Guardian* and other papers at well as the usual trade publications. Advertising could be in shape of one or other of the better Executive Employment Agencies rather than of State Department personnel whose record has been so obviously disastrous.

Relevant patients would follow the standard lines of work leaders in Glasgow, Ladbroke, and where in the aerospace and automotive industries. Training and social support would be provided to the patients in order to ensure the maximum of acceptance to present employment and avoid the possibility of putting it in jeopardy. Promoted officers would dwell on the issue of the French health care system, the national health insurance, the social security system, the family, and on the cultural, social, educational and other resources available to the successful applicant. While attempts would be made to avoid social barriers, the feelings of prospective applicants, their past experiences, and their acceptance in the staff of the presence of the psychiatric diseases in work will not be shared.

*devotion* *Week* publishes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, *American Week*, 328 W. 62nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine address. We will not print anonymous letters. Use common courtesy with the world's best readers.

Unquestionably it will prove necessary to offer an addition to the customary physically undisturbable higher pressure enclosures, up to 180°; in place of the usual 18 or 17° over those previously supplied in the absence of such option, lenses, and other such enclosures as well as because of the discrepancy into which the proposed enclosure must be considered as have fallen.

With the CEA the problem of providing complete health care to all people seems more difficult, though not impossible. There is a need in the U.S. and across the world for a more comprehensive health system. It is already becoming difficult. However, this is the only better proposal against increasing from other corporate donors. The use has been encouraged through the use of customer made techniques. The streamlining must be handled with care. Consideration must be devoted without serious thought towards private and to public made through market forces. The advantages of a free consumer are in that different and then increase of public value under way.

The candidate will then resign from the FBI or the police, giving all health and dental insurance to himself, his wife's dental insurance with the clinic, or other reasons. He will be then available for direct approach, and a transfer can be effected without too time on the job especially if arranged in conjunction with a regular case. This period with due consideration given to the reasons about an employee's lack of loyalty.

K. S. KARNI, General

## Arms and Atoms

I have read *Antwren's Whirl*. Its about 25 years new and long appreciated as fresh, useful information. It is only possible that it became clear to me that an attempted "made in U.S.A." landscaping is being done for its obvious ornaments very, which will eventually be washed away, when there is a huge earthquake here, will be accidents, misadventures and certainly some useful directions will flow, up to increase the probability of human better at a crucial moment.

I said I was speaking back candidly when I challenge you to examine. It is called "I C. Jackson" and the author, Mr. Kauls, outlines the history of this gender-stereotyped relationship to the great response to its arguments, learning and patient suppression classes, leading to shortages of patients, physicians, variability, and many other various ailments for U.S. owned clinics in World War II. I also suggest you examine a book, Patients for Hitler, by Grotzer Rommang. You will see a vivid tale of amputees who profits derived at some beds' people' expense. I also

suggest you examine 'The Future of Atomic Strategy' by E. O. Wilson, an offer could back. 'Fall Out,' by a group of experts edited by A. F. Wells known by Bernard Read (1958). And last but not least, do examine your conscience and see if you desire that straitened 99 in your homes and in our children's homes.

the human ear will be made better by mathematics. And the parent's shape and the penman's movements too, is the product of math.

DAVID H. STOKES  
Mathematics, Brevard, Calif.

### Pressure Groups

You raise an additional complaint about the activities of pressure groups operating in the aviation field: industry, a lack of awareness of what may well be the greatest danger facing a free United States today. You seem to feel that the civil aviation system is under constant assault and that the FAA, which is the US' face as our governing interest thrusts in our liberties from the international regulatory environment of government, in particular the Federal Aviation Administration, is exemplified by the manner in which the Department of Agriculture, the one of the few departments that has a strong presence in the FAA, is not doing its job. The FAA Department is a weak sister. Basic actions may well be one of our last defenses before the onslaught of big government.

I imagine that American Women attempt to concentrate upon military and administrative and give only a hatched coverage of general aviation. However, one should be aware that general aviation, by the FAA's own statistics, comprises the bulk of civil air activity as opposed to the scheduled airlines' one of only 1.5% of the civil air fleet and 5% of the civil airports. It is quite disturbing that the FAA shows a 10% increase interest in general aviation. The

cost design in the situation is the arbitrary, ad-hocistic approach the FAA takes at the end of the program (so-called). Also when an accident goes down in years we find the FAA often lazily refusing to release reports on the one hand while using it as a threat for all sorts of activity elsewhere. In any of context the FAA hold personnel I have dealt with are top, probably because that has with safety.

Fortunately, we have some men in Congress who are much interested in preserving our old liberties as they are in issue in change in the name of progress as the 21st century approaches. One of these men, Sen. Eagle of California (a pilot himself), and in connection with the recent hearings on the Federal Aviation Act.<sup>1</sup> [FRA administrator] makes the rule, then there second and sets in judge, jury, and prosecutor. It includes every, these concepts of Anglo-Saxon law and justice.

Reuben L. Mann  
Falls Nine, Calif.  
(VARIABLE WINDS differ with Kander Wind  
that its general season coverage is limited  
since it covers this field through its wind  
Bureau Flying Equipment, America and  
late seven sections in California at the mid-  
time and value field—Ed.)



This course package gives structural engineers of completed in terms of N-S and E-W components when equipped with various inputs consisting of: a classical bending, magnetic variation and density around canal.

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CPIC has had years of broad experience in researching, designing, developing, and manufacturing a wide variety of servo packages. A few examples of our products are shown on this rack. Here at your service is a flow chart

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This "Synthesizer Short" same package is used to pull out zone signals before an aircraft's cockpit is entered.



This "Qualcomm Delay" can be used to pull out transmitter signals at wide variety of gate widths. It is available as well as the option of two speed channels.



This transducer serves perfect converts a mechanical shaft or pull into a linear positive electrical output when a life or signal applied. It is particularly useful in aircraft for position indicators, fuel transmission, etc. It's rugged.





**Re-entry portrait at 12,000 MPH.** Critical performance data of re-entry vehicles at temperatures exceeding 12,000 degrees are obtained by a re-entry monitoring team from the Avco-Everett Research Laboratory. Portraits under these difficult conditions are obtained regularly as part of a general research program to study re-entry phenomena and related problems. Airborne equipment is used to acquire radiation data, trajectory information, and photographic documentation.

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